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The Normal Stomach and Small Intestines in the Infant[1]

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THE GASTRO-INTESTINAL tract has long been a rich field for the writing of technical papers, and roentgenologists have done their share to swell the volume of material. No matter who the essayist, however, his conclusions have been based, almost without exception, on consideration of the adult alimentary tract and its changes of form and reactions to disease. Little effort seems to have been expended on investigation of the normal gastro-intestinal tract of the infant and child and its early variations from the average normal.

In the beginning of sound scientific knowledge, animal investigation was the only method available; hence conclusions as to the human being were drawn from known facts about the animal. Such information compared with a knowledge of adult pathological conditions as revealed during surgical procedures or at necropsy, and perhaps foreshadowed in roentgenographic examinations, has served to supply our conception of the child's anatomy and physiology. That, however, may not be the best approach to the study of disease. The development of the stomach and intestines is freely described in embryologies, but I have been unable to find in the literature any study of the development from the infant to the adult type. The pattern of the infant's gastro-intestinal tract as portrayed by the roentgen ray is entirely different from that of the adult. The question then arises, why this difference, what is its cause?

In studying the gastro-intestinal tracts of 200 infants, I was confused because the intestinal pattern was so different from that of the adult. I could not find in the literature any explanation of the sequence of developmental events which caused this difference, and therefore I decided to clarify the condition by beginning my studies with the fetus.

Through the co-operation of Saint Anthony's Hospital, Denver General Hospital, and Children's Hospital, I obtained fetuses of three months, four months, six months, and nine months, and the gastro-intestinal tracts of infants who had died at birth, at ten days, and two months of age. The gastro-intestinal tracts were photographed, fixed in formalin, and stained with hematoxylin and eosin. They were cut in sagittal and cross-sections, and both black and white and color photographs and photomicrographs were made. These were carefully indexed and filed for study.

I would like to review briefly the main points in the embryological development of the alimentary tract (1). At first it is a straight tube, or, in fact, two tubes, one internal and one external. The internal

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tube, entoderm, becomes the epithelial lining and the glandular ingrowths. The external tube is the investing layer of the splanchnic mesoderm and develops into connective tissue, muscle, and surface peritoneum. Since the mucosal lining develops more rapidly than the external layer, it is thrown into folds which form the mucosal folds of the intestine and the rugae of the stomach. In a 4 mm. embryo the stomach is a spindle-shaped enlargement of the fore-gut. It is originally high, but due to the forward growth of the cephalic end of the embryo it is in its permanent position in the abdomen at the end of the seventh week.

According to the anatomists, the stomach of the newborn child lies vertically, with the greater curvature to the left and the lesser curvature to the right. It is generally stated, also, that the infant stomach lacks a fundus. To that conclusion information resulting from radiographic studies is radically opposed. Lewis' study (4) on the development of the stomach showed that all subdivisions are present in the fetal organ, and this observation is corroborated by my own findings, as is demonstrated by Figure 1-A, showing the gastro-intestinal tract of a three-month fetus before the liver has been removed, and Figure 1-B, after the liver has been removed. The fundus and subdivisions of the stomach are definitely recognizable. The rugae are present and increase in development with the growth of the fetus. The musculature is poorly developed, but as the fetus grows it also develops, and the rugae become more prominent. At the pylorus, the musculature is well developed and prominent, as are the mucosal folds. The duodenum is not yet differentiated, and the muscular coats are poorly defined. The jejunum is a small coiled narrow tube, as shown in Figure 1-C. It is so small that it is difficult to visualize the mucosal folds, except in the photomicrograph (Fig. 2). The ileum also is a coiled narrow tube and shows the same gross characteristics as the jejunum.

On the whole, the nine-month fetus shows little basic difference. The stomach is larger, the rugae are more developed, the pylorus is moderately defined. The duodenum is about as it was at three months except for the further development of the muscularis. The folds of the jejunum are prominent, and although the muscularis is still imperfectly developed, the junction of the jejunum and terminal ileum shows a definite change of structure, as illustrated in Figure 3. I was unable to find any mention in the literature of a similar observation. The gross examination of the ileum shows it to be like that of the three-month fetus—that is, grossly similar to the jejunum—but microscopically there is a difference, although the muscularis coat is practically the same. In cross and sagittal sections, Peyer's glands are found, and the mucosal folds are less prominent.

A study of the newborn child elicits certain changes, most of which conform to expected features due to growth and development. In a ten-day-old infant which died of a heart condition, the stomach was larger, the rugae more prominent, and the muscularis more developed; but the pylorus, duodenum, and small intestine showed the same general characteristics as in the nine-month fetus. After observing some of our findings, as well as those of Dr. John Caffey and Dr. G. Wetzel (5), Dr. Ross Golden (3) commented that between the first and third or fourth months of life no mucosal folds in the jejunum can be identified on the roentgenogram. My findings confirmed Wetzel's statement (5) that "the mucosa in the intestine of the newborn infant is both absolutely and relatively more developed than the muscle coat." It has been shown that the mucosal folds are present as early as the third fetal month. The explanation of their failure to appear in roentgen examination of the very young infant is, I believe, that the meal causes the mucosal folds to flatten out, since the muscularis is not sufficiently developed to produce the characteristic adult pattern. Besides, the muscle relaxes and there is no definite pattern. Doctor Golden (2) suggests that the change

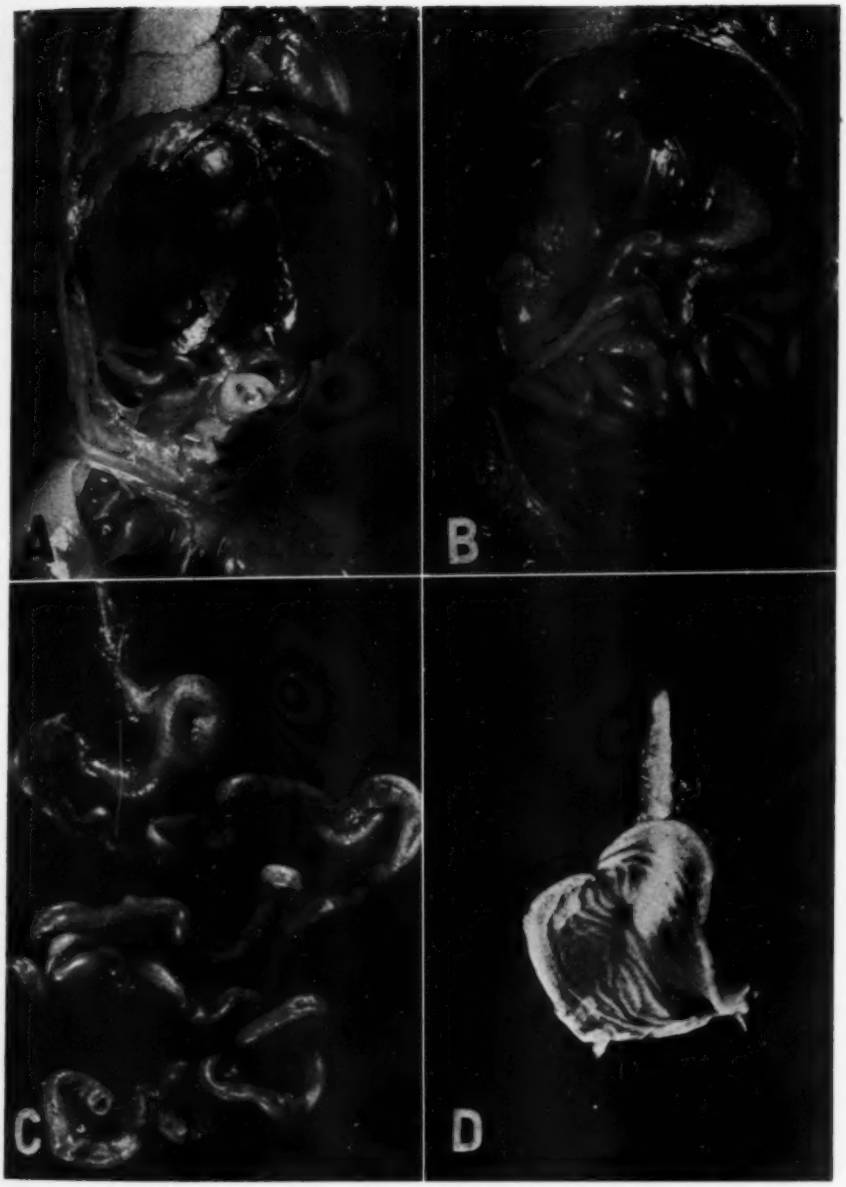

Fig. 1. A. Three-month fetus: abdomen opened, liver very large, filling most of abdomen. A few loops of small intestine show below lower edge of liver.

B. Liver removed, divisions of stomach—cardia, greater curvature, lesser curvature, and antrum—demonstrated, as in adult. Small intestines coiled but not differentiated; no blood vessels showing.

C. Stomach and small intestines removed from body; general characteristics as in 1-B.

D. Enlargement of open stomach, showing rugae. Stomach wall of thin paper consistency.

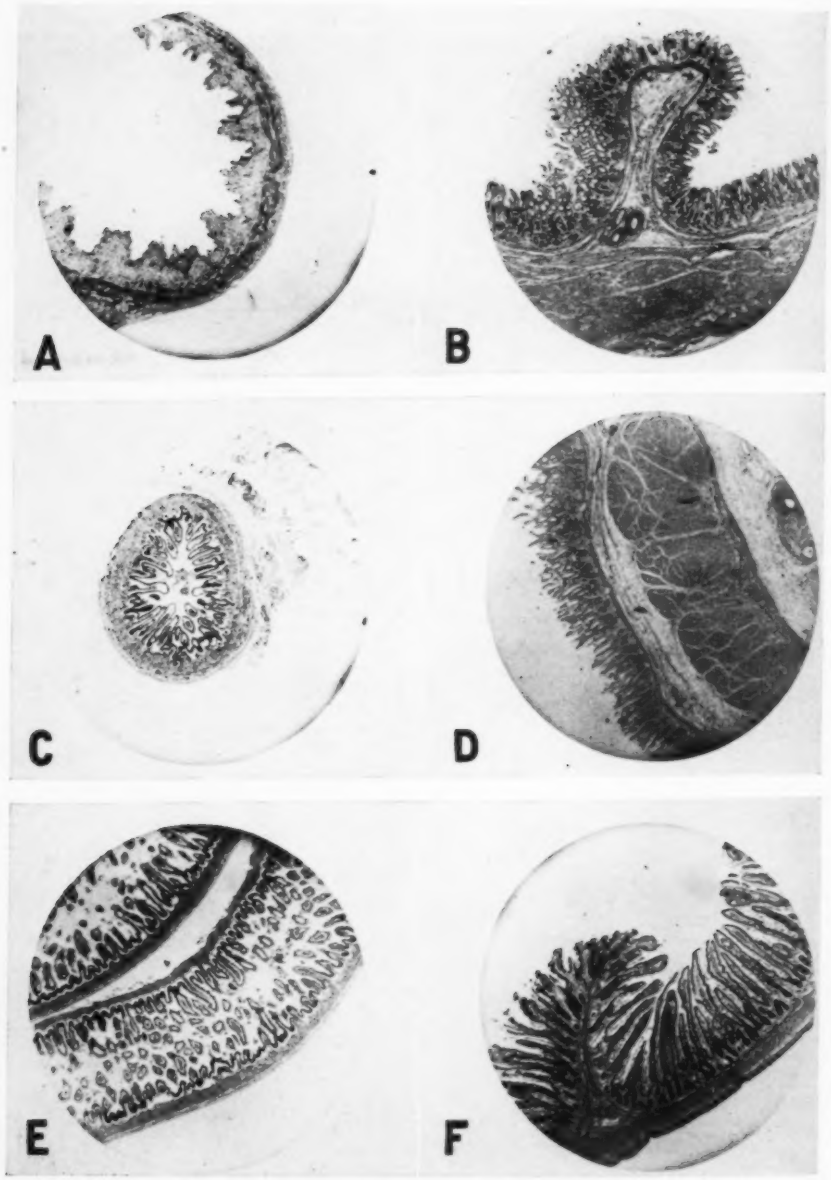

Fig. 2. A. Photomicrograph of stomach of three-month fetus; rugae prominent, submucosa poorly developed, muscularis poorly developed, not extending into rugae.

B. Lesser curvature of child ten days old; mucosa, submucosa, and muscularis more developed; muscularis shows most change, being more developed than other layers, and extends into rugae.

C. Duodenum of three-month fetus; mucosal folds distinct, submucosa poorly developed, muscularis poorly developed.

D. Duodenum at birth; mucosa, submucosa, and muscularis more developed than in fetus.

E. Jejunum of three-month fetus; mucosal folds distinct, submucosa and muscularis layers poorly developed.

F. Jejunum of child ten days old; mucosal folds well demonstrated, submucosa layer thin, muscularis layer well developed.

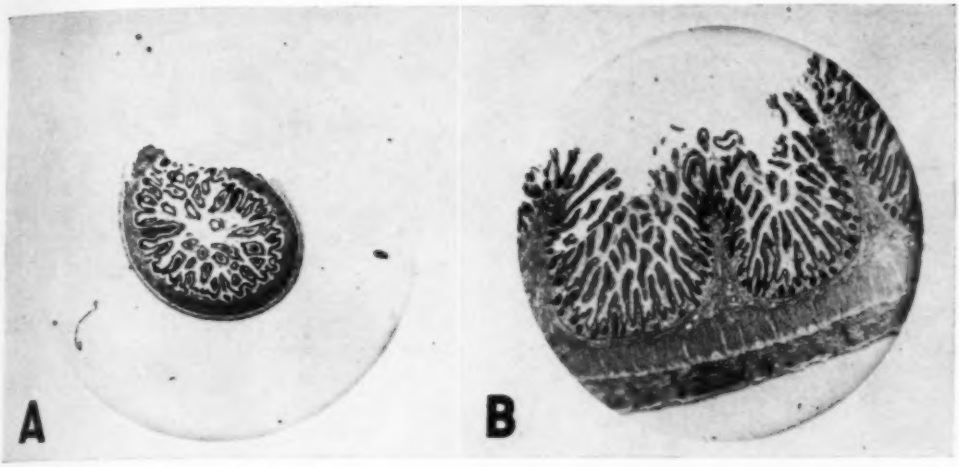

Fig. 3. A. Photomicrograph of ileum of three-month fetus; mucosal folds demonstrated although mucosa is poorly developed; submucosa only slightly developed, muscularis poorly developed.
B. Photomicrograph of ileum of child ten days old; mucosa developed, submucosa layer well developed, muscularis layer markedly increased, extending into mucosal folds.

is due to the difference of the intramural nervous system of the newborn and the older child.

At the time of birth, before the child has taken a breath, the chest and abdomen produce one dense shadow with no defining limits. After the first breath, there is delineation of the chest and abdomen because of air entering the stomach and the lungs. This differentiation continues to be more marked hourly as the child gets older. About 24 hours are required for the air to reach the rectum. This observation was an important clinical aid in diagnosing a case at Children's Hospital, Denver, a few months ago. The baby, five days old, was vomiting its food and had had no bowel movement. It was brought to the x-ray department for study of a possible atresia of the esophagus. The plain film of the abdomen showed no air in the intestinal tract below the upper jejunum (Fig. 5). Diagnosis was made of upper jejunal obstruction, and at operation a volvulus with rotation of the jejunum was found. As soon as the surgeon released the rotation, air was seen traveling down the small intestine.

The color of the colon is another index which may be of diagnostic significance. Meconium stains the colon a dark green. In the case mentioned the colon was dark green in color, and from that observation it was possible to state positively that the colon was normal. Necropsy findings confirmed the diagnosis.

Study of roentgenographic examinations of the gastro-intestinal tracts of 200 infants lead me to the following conclusions, which have proved valuable in the diagnosis of abnormalities and disease of that system in children. In the infant, the stomach is high in the abdomen, usually transverse in position, with the lower border of the greater curvature above the level of the third lumbar vertebra. The stomach may assume any one of several shapes, depending on the age of the infant, the amount of air it contains, and the amount of the meal given. The commonest shapes are: pear, ovoid, and occasionally steer-horn. Nor is the appearance the same at all examinations. Under the fluoroscope as it fills, the stomach appears to move outward toward the anterior abdominal wall and slightly downward and to the right. In the postero-anterior view this relation completely obscures the pylorus and the duodenum. The meal starts to leave the stomach immediately. In the stomach of a

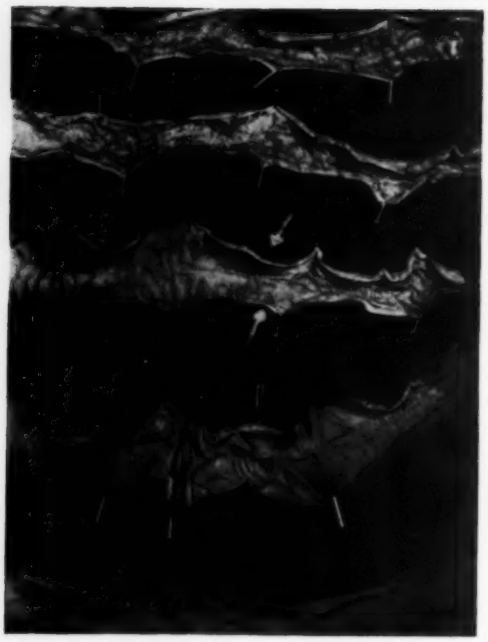

Fig. 4. Small intestines of infant at birth: longitudinal view at junction of jejunum and ileum; demonstration of difference in mucosal pattern of jejunum and ileum.

normal infant under three months of age, there is seldom any evidence of a peristaltic wave. The stomach appears to contract gradually in its entirety and seems to shrink in size in all dimensions as the contents enter the small intestines.

The pylorus is not distinct, as it is in the adult, due apparently to incomplete development of the musculature. The position of the pylorus varies according to the distention of the stomach; it is very movable in the transverse and anteroposterior directions. It is not higher than the lesser curvature of the stomach, and is usually slightly lower.

The duodenum is of especial interest, as the first portion is behind the pyloric end of the distended stomach and is not visible in postero-anterior views. The infant must be rotated to the right, to about a 60° angle to show the pylorus and duodenum. The duodenum is like that of the fetus, a more or less short, straight tube, for the first three months. The first portion, as a rule, is in the horizontal position and lies at the level of the first lumbar vertebra. The second and third portions are hard to visualize, probably because of rapid emptying. When they are visualized, they have the same characteristics as the first portion.

In the jejunum and ileum, the meal does not have the "snow flake" appearance that it has in the adult. It is segmented and grouped. In the first few months of life, the segments vary in size and shape without any definite form. The intestinal wall has a thin, paper-like consistency.

The following histologic observations were made in the fetus:

1. The mucosal folds and valvulae conniventes are more abundant, but their length and height are distinctly less than those of the adult.

2. The mucous membrane is absolutely and relatively more developed than the musculature. It is also extremely delicate and vascular, and more cellular than that of the adult.

3. Compared with the adult structures, the submucosa is less and more delicate in character; the elastic fibers are very feebly developed.

4. The muscularis develops gradually from a very thin layer to a thickness equal to that of both mucosa and submucosa.

5. The anatomical variations of the mucosa, submucosa, and muscularis noted probably explain the segmentation and grouping of the meal in the jejunum and ileum of the infant.

SUMMARY

Postmortem macroscopic, microscopic, and photographic studies were made of the gastro-intestinal tract in fetuses and in infants who died at birth or shortly thereafter. The necropsy findings were correlated with roentgen examinations of 200 infants. The data so obtained establish the following information:

1. The fetal and infant stomach has all the characteristic subdivisions of the adult organ, but muscular development is lacking. Rugae are present, and the pylorus is well defined. The stomach corresponds

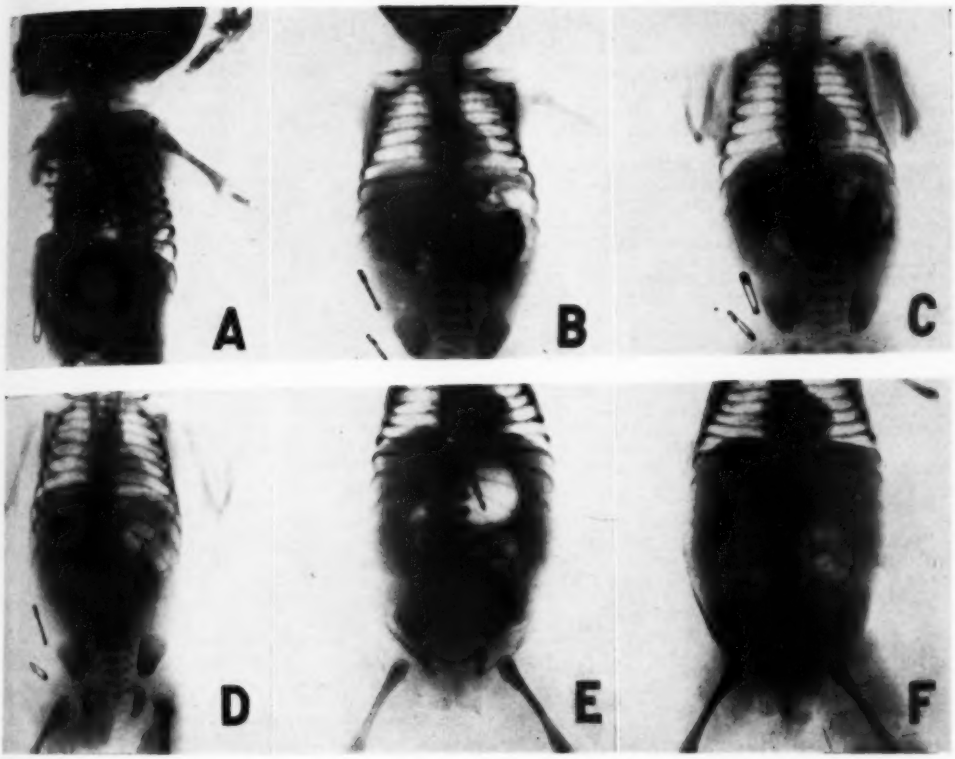

Fig. 5. A. Roentgenogram of child five days old. Catheter in esophagus, air in stomach and duodenum, none in remainder of gastro-intestinal tract.
B. Thirty-minute film: Barium meal by catheter definitely ruled out atresia of esophagus; stomach normal, no meal beyond duodenum, no air in intestines.
C. Four-hour film: No barium meal beyond duodenum.
D. Twenty-one-hour film: Small amount of barium meal in stomach, none beyond duodenum. Diagnosis: Obstruction of upper jejunum.
E. Roentgenogram three days after operation (child now nine days old): Catheter in stomach; no air in lower jejunum, ileum, or colon; obstruction persisting. Operative findings: Volvulus of duodenum, intestines beyond obstruction collapsed as in stillborn child.
F. Roentgenogram four days later (child now thirteen days old): No change in air content of intestinal tract; obstruction persisting.

in shape to that of the adult, but in the infant the position is always high.

2. The duodenum appears more like a tube and does not show the divisions of the adult duodenum.

3. The jejunum and the ileum are also less developed than in the adult.

4. The structure of the mucosal folds changes in character at the junction of the jejunum and the ileum in the infant at birth.

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The Colon in the Healthy Newborn Infant[1]

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In spite of the rarity of roentgen examinations of the colon of the newborn infant in routine practice, it is necessary for the radiologist to have a well founded knowledge of the appearance of the normal colon at this and subsequent ages. This paper presents the roentgen findings on barium enema study of the colon in a group of 105 healthy newborn infants, of whom 51 were white and 54 colored. Fifty-three were boys and 52 girls. None of these babies had any gastro-intestinal disturbances. They were, with 6 exceptions, full-term children, varying in age from two to eight days. The smallest infant weighed at birth 2,385 grams; the largest, 4,755 grams. Two of the mothers had positive tests for syphilis. The remainder were serologically negative.

The infant is even less co-operative than some of our adult patients. Consequently, one must have at hand a simple but satisfactory method for examining the large bowel. After an opaque meal has been given, barium can be seen entering the cecum and ascending colon in three to six hours, and in eight hours the entire colon may be visualized (6). Distribution of the meal throughout the colon, however, is so scattered that a satisfactory view is rarely obtained. Not only is it difficult at times to distinguish between ileum and large bowel, but in one infant the meal may have only entered the cecum in eight hours, while in another evacuation of the head of the barium column may have occurred. This may necessitate roentgen study at least at hourly intervals, and after all this work one may have adequate information only on colonic motility, and little or none on form and size. It is, therefore, evident that the colon is best examined by administration of a barium enema.

Larimore made barium enema studies on 102 newborn babies, ranging in age from six and a half hours to thirty days (8). He found that frequently the right colon and the cecum could not be filled. Complete failure of the colon to fill was often encountered because of its intolerance to the enema. Larimore's work demonstrated variations in total length and regional topography of the infant's colon, analogous to those seen in the adult. Local redundancies and hyperrotation and descent of the cecum with increased total length of the right colon were observed.

Bryant measured intestines removed at autopsy from 45 fetuses, 37 children, ranging in age from six months to seventeen years, and 160 adults (3). He concluded that the most striking characteristic of the human intestine is extreme variation in length, this variation averaging about 100 per cent. Variation in length, Bryant found, begins at or before the fifth month of intra-uterine existence and thereafter is evident throughout life in both the small and large bowel. The characteristic 100 per cent variation in length is present at birth as at all later periods of life. The sigmoid loop, according to Bryant, is not always of excessive length; on the contrary, it is not infrequently shorter in length, at birth, than would be considered normal.

Peteri examined the large intestine in 28 infants and children, with a thorium mixture (10). An obturator was used to retain the mixture in the colon during the examination. He found the opaque enema study to be of value not only in determining normal variations in the configuration of the large bowel, but also in observing the function, peristalsis, anti-

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peristalsis, and other muscular contractions of the colon.

Chapin studied a group of infants between the ages of two and twenty-five months and concluded that the hitherto supposed "high enema" was based on a fallacy (4). He found it was practically impossible to pass a high tube around the sigmoid flexure. In preparation for the enema he gave the infant a tablespoonful of castor oil. One-half hour before beginning the study 8 drops of paregoric were given and the rectum was then painted with 2 per cent cocaine solution. With the enema bag at a height of 4 inches and with the tube inserted into the rectum a distance of 4 inches, it was found possible to fill the whole colon without force.

Bouslog, Cunningham, Hanner, Walton, and Waltz examined 100 infants, none of whom was over ten days of age (2). Each infant was given a barium enema consisting of about 30 c.c. of a mixture of 5 c.c. of 2 per cent gum arabic solution and 8 grams of barium sulphate for each ounce of water. The enema was given through a small catheter and a film was then made in the postero-anterior position. It was found that many of the infants did not retain the enema long enough to permit a satisfactory roentgen examination, and the colon was filled around to the cecum in only 18 cases. Some redundancy of the sigmoid was present in all cases, this being marked in 62 infants. Colonic spasm was seen frequently. Haustrations were observed in several instances but were poorly marked.

EMBRYOLOGY OF THE COLON

In order better to appreciate the appearance of the newborn infant's colon, the following brief review, taken from the works of Arey (1) and of Jordan and Kindred (7), is presented.

In embryonic life the hind-gut develops into the colon. Very early in the growth process from the 5 to 9 mm. stage the development of a cecal bud serves to differentiate the small from the large bowel. The cecum itself develops from the proximal part of the cecal bud, while the appendix is derived from the distal portion. From about the seventh to tenth week of fetal life the small intestine and a part of the primitive colon are contained in the umbilical cord, due to the limited amount of space in the abdominal cavity. Upon leaving the umbilical cord in the tenth week, both small and large bowel are contained in the left side of the abdomen, the only available space at this time. The ascending and transverse colon, which are derived from that portion of the end-gut next distal to the cecal bud, gradually migrate from this position in the left lower quadrant. The fetal liver shows slow relative decrease in size, the hepatic flexure becomes evident, and the cecum moves across to the right side of the abdomen. Elongation of the ascending colon begins to occur as the liver "diminishes" in size. The cecal bud grows to form a blind sac, which results in extension of the large intestine beyond its junction with the ileum. The distal end of this blind sac develops rapidly for a time to become the vermiform appendix. About the end of the fifth month of intrauterine life this rapid growth of the distal end of the sac is no longer evident, but the remainder of the sac continues to grow at a pace similar to that of the remaining large bowel. In consequence, the cecum and appendix together become funnel-like in form, the vermiform appendix forming the stem of the funnel.

The most distal portion of the primitive hind-gut is the forerunner of the splenic flexure, descending colon, sigmoid, and rectum. Prior to the differentiation of the hind-gut into ascending and transverse portions, the colon passes obliquely upward from the cecum to the left of the stomach. Here it comes acutely downward as the splenic flexure, then continues as the future descending colon. As noted previously, during the period when the fetal liver "ascends" due to longitudinal body growth, the hepatic flexure appears, thus separating the ascending colon from

the transverse segment. This latter portion passes in front of the duodenum. The sigmoid becomes differentiated during the third month. Due to continued elongation of the large intestine from the fourth month of fetal life to the fourth postnatal month, the sigmoid flexure is pushed caudo-medially on the left side and the descending colon is thus established. At the eighth week of intrauterine life the anal membrane ruptures. The rectum is formed by subdivision of the cloaca. The enterodermal rectum then unites with a short ectodermal proctodeum, to form the anal canal.

METHOD OF EXAMINATION

When this investigation was first begun a satisfactory means of retaining the barium mixture in the colon was lacking. Several attempts were made to inject the enema through a catheter under fluoroscopic guidance, with the hope that a spot film could be made before evacuation occurred. This practice was very time-consuming and so many of the results were unsatisfactory that some other means of examination was found necessary. A hole just large enough to accommodate a small rubber catheter was made in a rubber stopper. The catheter was passed through this opening a distance of 1 1/2 to 2 inches beyond the small end of the stopper and then inserted into the infant's anal canal. An assistant then held the child's feet with one hand while the other hand made firm pressure with the stopper against the anus. In this way any desired amount of barium could be injected into the colon and retained until films were made. The fluoroscopic shutters can be kept closed to such a degree that no primary radiation strikes the assistant's hand. Since the possibility of exposure of the hand is always present, however, leaded gloves were tried, but with these the rubber stopper could not be properly held. The plan which was finally adopted was to have the assistant wear surgeon's rubber gloves, while a lead plate, measuring 6 × 10 inches, was placed on top of the fluoroscopic table under the hand. With fluoroscopic guidance the cephalic edge of this plate is pushed under the infant until it completely obscures the rubber stopper. Both fluoroscopic and radiographic studies can then be made without fear of exposure of the technician. It may be desirable to make at least one exposure with the overhead tube after completion of the fluoroscopic study. In this event the lead plate is removed from the table and placed on top of the assistant's hand, pressure on the rubber stopper being maintained until all desired films have been exposed. (See Fig. 1.)

In preparation for the opaque enema study the infant is given a cleansing enema in the nursery. The amount of barium sulphate powder used will depend upon the examiner's preference. We have tried and now use routinely the mixture recommended by Bouslog and his co-workers (2), that is, 5 c.c. of 2 per cent gum arabic solution and 8 grams of barium sulphate to each ounce of water. This is very satisfactory since the barium remains in suspension much better than in the straight watery mixture, and this amount of barium gives sufficient density on the films.

Considerable attention has been paid to the amount of mixture to be injected. It has been found that the best films in the newborn are obtained by placing 3 ounces of the barium mixture in the enema can, the latter at a height of 15 inches above the table top. With only 3 ounces in the container it is usually impossible to inject more than 70 c.c., but this amount will completely fill the colon around to the cecum (Fig. 1). In order to fill the terminal ileum it is frequently necessary to have a larger quantity in the can. However, when enough pressure is used to fill the ileum, so much small bowel is apt to be visualized that the outlines of the cecum and ascending colon and often of a part of the sigmoid are obscured (Fig. 2A). We have tried putting 6 ounces in the enema can and have found

that this amount of pressure may fill the terminal ileum to an undesirable degree, although only 80 or 90 c.c. may be actually used for the enema.

After the injection has been completed and films have been made, the infant is allowed to evacuate the enema. Frequently only a small amount is expelled immediately after removal of the stopper. Gentle massage of the abdomen will greatly assist in the process. In a number of instances a small amount of air has been injected after evacuation of the barium to secure a double contrast effect. The air is injected with very gentle pressure of the air bulb and it is always carefully watched as it goes around through the colon. In spite of this, in one case the ileocecal valve was so relaxed that an appreciable amount of air passed into the terminal ileum (Fig. 2B).

ROENTGEN FINDINGS IN THE NEWBORN

A general survey of roentgenograms of the barium-filled colon in various newborn infants discloses, as has been observed by Bryant (3) in autopsy material, a marked variation in total length of the colon. Some colons show only slight redundancy, while in others there is so much reduplication that it is extremely difficult to follow the course of the bowel. Marked differences are also observed in different infants in the position of various parts of the colon, the size of the lumen, haustral markings, and the amount of barium evacuated spontaneously after the enema. Irritability of the infant large bowel following injection of barium, although often present, was not any more noticeable than in the average adult.

The contour of the colon in the newborn is almost invariably smooth, in spite of the fact that the preliminary cleansing enema is at times not effective in removing colonic contents. The fecal material in the newborn colon is, of course, mushy in consistency, and one would not expect to see filling defects due to retained inspissated feces. In 2 babies of this group of 105, however, a ragged mucosal contour was noted in a part of the large bowel, and it is assumed that this was the result of something adherent to the bowel wall (meconium or feces?). In one of these two cases the defects were unusually prominent but confined to the descending and upper sigmoid colon (Figs. 3A and B).

It has been previously noted that Bouslog and his co-workers observed haustrations in the infant colon in a number of their cases, but they were poorly marked (2). In general, our experience is similar. In 24 babies no haustral markings were visualized. Where only one or two markings were observed in the entire colon, the case was listed as negative. However, 81 of the infants presented definite haustral markings, 60 of these being shallow, 19 moderate in depth (Fig. 4), and 2 marked. In these last 2 cases the appearance was as pronounced as is commonly seen in the average adult. The transverse portion appears to be the most common site for these recesses in the colon, although they are seen quite frequently in the ascending and descending divisions, less often in the sigmoid. Haustrations are usually much more evident after evacuation of the enema.

An attempt was made to classify the sigmoid as to size of lumen, degree of redundancy, position in the abdomen, length, and height of the upper flexure in relation to vertebral levels. As noted in Table I, a high degree of redundancy was encountered, in agreement with the findings of Bouslog and his associates (2). It has been noticed that if only a small amount of barium mixture is injected under low pressure, the sigmoid may not appear very redundant. However, as the pressure is increased and additional barium flows into the colon, the sigmoid is seen to be capable of much dilatation and apparent elongation (Figs. 5A, B, and C), and the visible redundancy thus may depend in part on the amount of mixture used. This is particularly true if the ileocecal valve is not relaxed. Perhaps this explains the discrepancy between the usual roent-

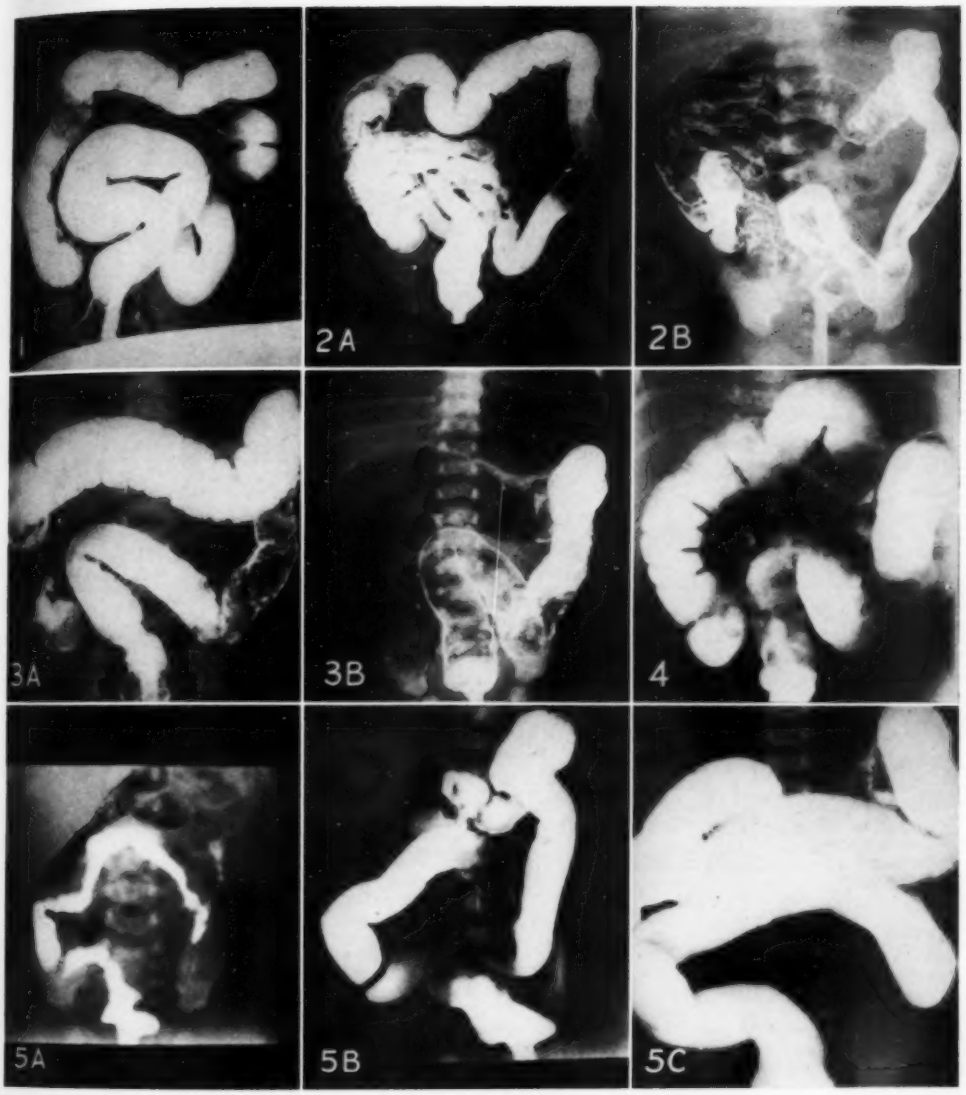

Fig. 1. Black female (No. 7676), age 2 days. The colon has been completely filled with barium. Note rubber stopper through which the catheter passes. The base of the stopper is hidden by a lead plate.

Fig. 2A. Black male (No. 7688), age 3 days. A considerable quantity of barium has passed into the lower ileal loops, obscuring the cecum, ascending colon, and a part of the sigmoid. The amount of opaque mixture injected was less than 3 ounces, but the ileocecal valve was not functioning well.

Fig. 2B. The same infant as in 2A, after evacuation and air injection. Although only light pressure was employed, much air entered the terminal ileum.

Fig. 3A. Black male (No. 7675), age 4 days. There are distinct filling defects in the mucosal contours of the descending and upper sigmoid colon. It is believed that this may be due to meconium or feces adherent to the mucosal surface.

Fig. 3B. Same infant as in 3A, after evacuation and injection of air. The ragged mucosal contours are no longer evident. Perhaps tenacious meconium or feces have been removed by the barium enema.

Fig. 4. Black male (No. 6034), age 4 days, showing moderate prominence of haustral markings.

Fig. 5A. Black female (No. 5606), age 2 days. The sigmoid is partly filled with the opaque mixture but it appears short, with a rather narrow lumen.

Fig. 5B. Same infant as in 5A, after more filling of the colon. The sigmoid now appears longer.

Fig. 5C. In the same infant, following complete filling of the colon, the sigmoid is seen to be definitely redundant, with one loop in the right and one in the left abdomen.

TABLE I: SUMMARY OF FINDINGS ON ROENTGEN EXAMINATION OF COLON BY BARIUM ENEMA IN A GROUP OF 105 HEALTHY NEWBORN INFANTS

0 = None. + = Slight. ++ = Moderate. +++ = Marked.
A = Average. L = Large. S = Small (L and S under "Length" = Long and short, respectively).
M = Mid. Rt = Right. Lt = Left.
L_2 = 2nd lumbar vertebra; L_3 = 3d lumbar vertebra, etc.
TIC = Top of iliac crest.
RIF = Right iliac fossa.

CONTOUR OF COLON	Smooth..... 103	Defects in contour (due to adherent meconium or feces?)..... 2			
HAUSTRAL MARKINGS	0.....24	+....60	++..19	+++.2	
SIGMOID	Size of Lumen: A 77, L 25, S 3	Degree of Redundancy: + 9, ++ 71, +++ 25	Position in Abdomen: M 60, Rt 34, Lt 11	Height of Upper Loop (Vertebral Level): T_{11} 1, T_{12} 14, L_1 34, L_2 45, L_3 9, L_4 2	Length: A 54, L 48, S 3

REDUNDANCY OF COLON	Sigmoid	Descending	Splenic Flexure	Transverse	Hepatic Flexure	Ascending
0		72	70	65	22	94
+	9	23	32	24	54	9
++	71	9	3	15	24	2
+++	25	1	0	1	5	

CECUM	Height in relation to bony landmarks: L_2 2, L_3 6, L_4 13, L_5 5, TIC 26, RIF 53	Valve-like constriction between cecum and ascending colon...74	Directed medially or upward... 33
APPENDIX	Visualized..... 23	Not visualized.... 82	
TERMINAL ILEUM	Visualized..... 63	Not visualized.... 42	
AMOUNT OF ENEMA REMAINING IN COLON AFTER EVACUATION*	0– 5%..... 6 5–10%..... 4 10–20%..... 7 20–30%..... 4 30–40%..... 1		

* 22 examined.

gen findings and the observation of Bryant (3) that the sigmoid colon at birth is not infrequently shorter in length than would be considered normal.

In the majority of cases the sigmoid was located in the mid-line, with the upper flexure at the level of the first or second lumbar vertebra. A right-sided sigmoid was seen much more often than one confined to the left abdomen. The lumen was considered extremely large in 25 cases, but this, as indicated above, can be controlled in part by the amount of mixture injected. In 48 cases the sigmoid appeared unusually long. In most of these cases the upper flexure was very high in the abdomen, but in some a loop was noted in both right and left sides of the abdomen at the level of the second or third lumbar vertebra.

In addition to the constant finding of redundancy in the sigmoid, it is not uncommon to see reduplication of other parts of the colon. Thus, in the descending colon there were 33 cases in which a redundant loop was present. In 10 babies

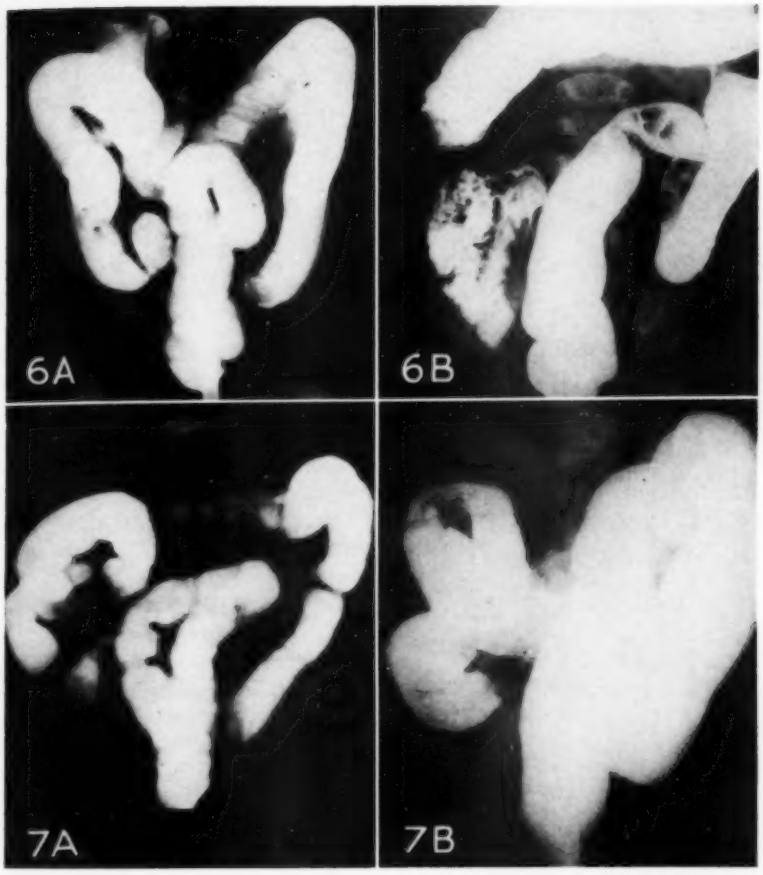

Fig. 6A. White male (No. 5543), age 3 days. Pronounced reduplication of the descending colon. Redundancy of transverse colon and of hepatic flexure is marked but in the ascending colon it is only slight. Note the valve-like constriction between the cecum and ascending colon. The cecum is directed medially and upward. Appendix visualized.

Fig. 6B. The same infant as in 6A, at 8 months. The reduplication of the descending colon remains pronounced, but in general the redundancy is very much less evident.

Fig. 7A. Black male (No. 6114), age 2 days. The cecum and appendix in this newborn infant have an appearance suggestive of an inverted funnel.

Fig. 7B. The same infant as in 7A, at 3 months. Note change in direction of cecum and loss of inverted funnel appearance.

this reduplication was pronounced (Figs. 6A and B).

As will be noted in Table I, the incidence of redundancy in the splenic flexure and in the transverse colon was about the same as in the descending portion. In the hepatic flexure, however, reduplication was very commonly seen. A simple flexure or bend was present in only 22 out of the 105 babies examined. Some degree of extra looping was noted in all the other cases, this being slight in 54, moderate in 24, and marked in 5 infants. On the other hand, the ascending colon presented some evidence of redundancy in only 11 instances. This took the form of either an extra loop in the mid portion or of a turn in the proximal end, in which case the cecum was usually directed upward.

In roentgenograms of the adult colon the cecum is commonly seen more or less clearly outlined from the proximal as-

cending colon, due to a rather well marked constriction. Generally, however, the separation is no more prominent than an ordinary haustral marking. This point of separation marks the location of the ileocecal valve, which is situated at the entrance of the ileum into the large intestine at the upper border of the cecum. The site of the valve is usually much more clearly demarcated in the newborn infant than in the adult (see Figs. 4, 6A, and 7A). A definite separation is seen here in the majority of infants (74 cases in this study), and it is probable that this constricted area would always be seen if the amount of barium mixture injected were restricted to 2 to 2 1/2 ounces. As previously indicated, the use of more barium than this is apt to result in a spill over into the terminal ileum, with resultant obliteration of adjacent structures. On the other hand, due to a poorly functioning ileocecal valve, a quantity of even less than 3 ounces of barium mixture may be more than is desirable (see Figs. 2A and B). On one occasion the cecum was seen filled with gas which sharply outlined it from the barium-filled ascending colon adjoining it.

The fetal type of cecum has been described anatomically as conical in shape, the appendix arising from the apex and forming a continuation of the long axis of the colon. We have found this appearance rather frequently in the newborn infant (Figs. 7A and B).

At times the cecum is directed medially (in 33 babies in this series). Occasionally it points directly upward, where the ascending colon is redundant in its proximal portion. In the majority of infants, however, the cecum is located immediately below the proximal ascending colon, appearing not unlike the adult organ.

Peirce presents an excellent review of the literature dealing with abnormal positions of the cecum, including the undescended cecum (9). He studied the colon by barium enema in 23 infants and children, 17 of these ranging in age from one to ten days. From his findings he concluded that (*a*) fault in normal descent produces the subhepatic cecum, (*b*) faulty fixation may result in retroperitoneal or retrocecal appendices, and (*c*) the previously held opinion that the cecum is in subhepatic position in the newborn and infant up to the fourth month is probably erroneous. His findings agreed with those of MacLean and Hertwig, *i.e.*, that descent of the cecum probably begins or is completed by the eighth month of fetal life.

Our study appears definitely to corroborate the results obtained by Peirce. In Table I the height of the cecum in relation to certain bony landmarks is tabulated for the entire group. It is noted that in 53 cases, roughly 50 per cent, the cecum was located in the right iliac fossa, as opposed to only 26 cases in which it was at various distances above the iliac crest. In 25 infants the lower border of the cecum was at the level of the iliac crest or slightly below, but the position was not such in these 25 that one could say it was in the iliac fossa.

It has been noted elsewhere that the appendix is rarely visualized in the newborn infant after administration of barium by mouth (6, 11). This is in contradistinction to adults, in whom the appendix most often appears at the six or twenty-four-hour interval after the barium meal. Visualization of the appendix was obtained, however, in 23 of the 105 infants examined by opaque enema, and it is probable that it would have been seen more often if barium had not passed over into the terminal ileum (see Figs. 6A and 7A). Some filling of the terminal ileum was observed in 63 cases.

Only 22 of this group were observed after evacuation to determine the amount of the enema remaining. It is seen on referring to Table I that evacuation was fairly complete in most cases, only 5 infants retaining more than 20 per cent of the mixture. Air was injected only in infants who were studied fluoroscopically after evacuation. The double contrast enema added little, if anything, to the

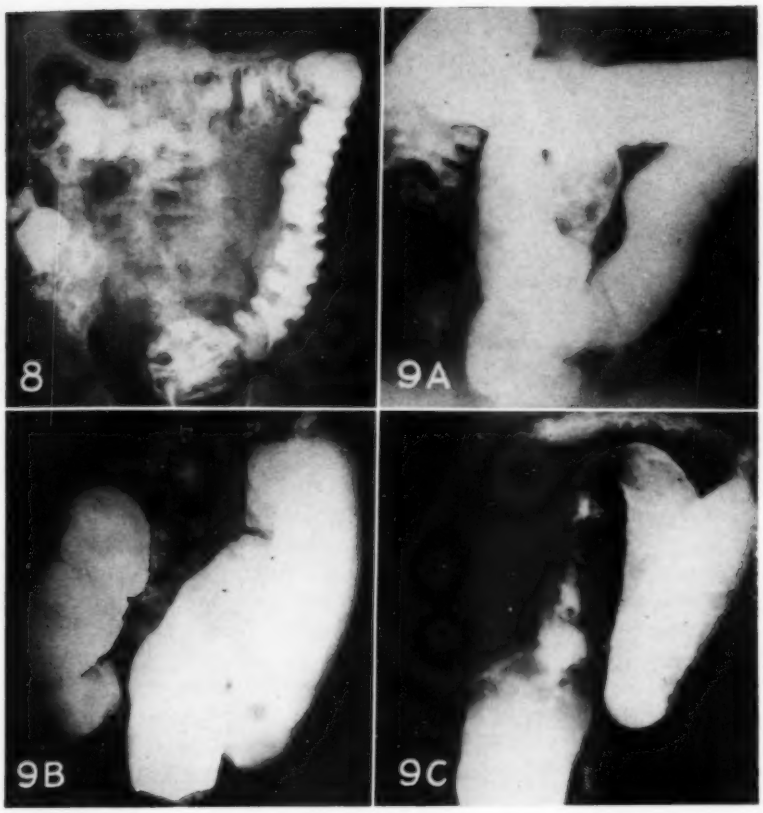

Fig. 8. White female (No. 5528), age 1 year, showing very definite haustrations. Film made following evacuation of barium enema.

Fig. 9A. White male (No. 5521), age 1 year. The large bowel is unusually capacious. A total of 625 c.c. barium mixture was required to fill this colon, the usual amount at this age being 350 to 400 c.c. This infant had never received any cod-liver oil.

Fig. 9B. Black male (No. 6100), age 8 months. Baby "constipated" and had received castoria every night. The lumen of the colon is large. Note the long, redundant sigmoid loop.

Fig. 9C. The same infant as in 9B, after partial evacuation of the enema. Note dilated recto-sigmoid colon.

portrayal of the roentgen anatomy of these babies, but it appears to be just as simple to make air studies in infants as in adults (see Figs. 2B and 3B).

STUDIES IN OLDER INFANTS

An attempt has been made to follow this same group of infants at later periods in order to determine when the infantile characteristics of the colon are superseded by adult features. Wasson has pointed out some of the differences in the anatomy, physiology, and pathology of the infant, young child, and adult (11). He stresses the need for further roentgen studies of the intermediate group—between the young child and the adult—in increasing our knowledge of the development of the gastro-intestinal tract. To date only 19 cases of our original group of 105 have been re-examined, and this is not a sufficient number to allow the adoption of more than generalized conclusions. There are two reasons for the difficulty experienced in these follow-up studies. The first and largest is the natural reluctance of the mother to return the child for a roentgen examination. The second reason

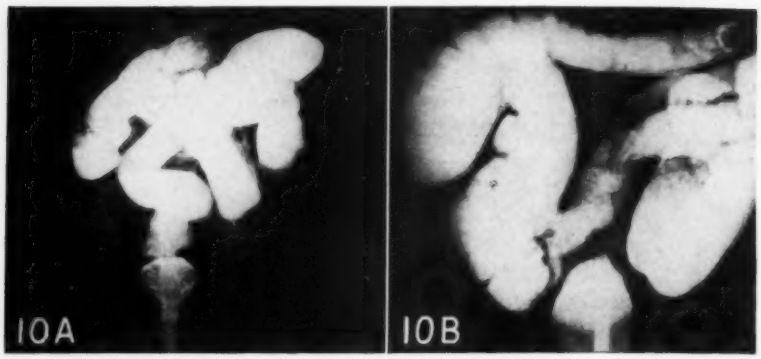

Fig. 10A. Black female (No. 6458), age 3 days. Redundant sigmoid, double splenic flexure, redundant hepatic flexure and *high cecum*.
Fig. 10B. Same infant as in 10A, at 5 1/2 months. The double splenic flexure has disappeared. There remain, however, marked reduplication of the descending colon and a redundant hepatic flexure. *The cecum is now in the right iliac fossa.*

is the increasing difficulty in restraining these babies as they grow older. Usually everyone in the department (except the infants) is thoroughly fatigued after examination of one or two sturdy one-year-olds.

Comparison of individual findings in the two groups, (*a*) the infants examined during the first ten days of life and (*b*) the same infants re-examined at varying periods from three months to one year of age, is difficult and perhaps of no great value. It is believed that as this study progresses, not only in age of the infants, but in the number re-examined, comparative findings may be more significant.

Haustral markings were seen in the older infants with but one exception, as compared with no evidence of haustrations in 10 of this group when newborn. Moreover, the recesses were deeper and also more frequent throughout the colon, as a rule (Fig. 8). The contours of the colon were smooth, as was observed in all but 2 of the entire group of 105 when newborn.

None of this special group of 19 revealed any defect in contour of the bowel on the first examination, but one infant when re-examined at the age of eleven months presented ragged mucosal contours in the ascending and transverse colon. It seems plausible that this might be the result of inspissated fecal material producing filling defects at this age, but it is certainly more difficult to explain it in the newborn (Figs. 3A and B). At autopsy in stillborn infants, however, tenacious meconium adherent to the walls of the colon has been seen (5).

There was an apparent appreciable increase in the number of infants showing a sigmoid with large lumen (Figs. 9A, B, and C). It is interesting to note that of the 7 older infants with large sigmoids, 2 had never received cod-liver oil, one had been given cod-liver oil only occasionally, and still another had not received it until seven months of age, six or eight weeks prior to the re-examination. A fifth infant, aged eleven months, had received cod-liver oil for only three months. This infant and the one who did not receive the oil until seven months of age, in addition to one other, were "constipated" and had been receiving cascara or castoria each evening. Another infant had received cod-liver oil regularly since early infancy and had 2 to 3 bowel movements daily without enemas or laxatives. Yet, approximately 30 to 40 per cent of the enema remained after evacuation.

Aside from these changes in the size of the lumen, only minor comparative changes were noted in the sigmoid. One would naturally assume that redundancy in this part of the large bowel would be much less evident in the older age group,

but the observations do not bear out such an assumption. Perhaps this opinion will have to be revised when it is possible to present a larger series of follow-up studies. The redundancy of the splenic and hepatic flexures and of the descending and transverse colon appeared to become less marked with increase in age and body size, as would be expected (see Figs. 6A and B). There were still 16 in the older infant group, however, who showed appreciable redundancy at the hepatic flexure. In most infants of eight months or older approximately 350 c.c. of the barium mixture are required for complete filling of the colon.

Probably as a result of longitudinal body growth and straightening out of the flexures of the colon there was a smaller number in the older group in whom the cecum was directed medially. While the appendix was visualized in 7 of the older group as compared with 3 in the newborn series of 19, this can hardly be considered significant (see Figs. 7A and B). As has been stated previously, it is probable that with greater care to avoid filling of the terminal ileum, the appendix could be seen more often in the newborn after a barium enema.

While it is desirable to avoid specific assumptions on the basis of such a small follow-up group of cases, it is interesting to note the considerable number of newborn infants with the cecum at the level of the iliac crest or higher, and further to observe the number in which a similarly high cecum was present in later infancy. In 5 of the older babies, on the other hand, the cecum was in a considerably lower position than when first observed (Figs. 10A and B). This might or might not afford some basis for the usual belief that the cecum descends in the abdomen after birth.

SUMMARY

Fluoroscopic and roentgenographic examinations of the colon by barium enema were made in a group of 105 healthy infants varying in age from two to eight days, for the purpose of studying the normal roentgen anatomy. It has been found that when a small rubber catheter, passed through a hole in a rubber stopper, is inserted into the anal canal a distance of 1 1/2 to 2 inches and then kept in position by means of manual pressure on the stopper, an enema can be given to an infant as readily as to a co-operative adult. Moreover, the infant can be obliged to retain the barium mixture until roentgenograms are made either with the spot film device or with the over-head tube. By using the same simple device a double contrast enema examination can be easily conducted.

Two to two and one-half ounces of barium mixture will completely fill the colon in the newborn infant.

Irritability of the large bowel following injection of barium is probably not more marked in the infant than in the adult.

The mucosal contours of the healthy infant's colon rarely show any defect. When such defects are present, it is believed that they may be due to adherent meconium or feces.

Haustrations in the newborn are nearly always present, but they are more shallow and less numerous than in older infants and adults.

Roentgen studies would indicate that the sigmoid is always redundant in early infancy, but this may sometimes be overemphasized if too much barium mixture is used.

Redundancy of the descending colon, splenic flexure, transverse portion, hepatic flexure, and ascending colon was encountered frequently, but it occurred most often in the region of the hepatic flexure, being about as common here as in the sigmoid.

The cecum was found to be at the level of the right iliac fossa in 50 per cent of the infants in this group. In 25 per cent it was located above the level of the iliac crest, but a true subhepatic cecum was not found.

The appendix was observed in 23 cases. This is in contradistinction to the fact

that the appendix is rarely seen in the newborn after a barium meal.

The terminal ileum is easily visualized, but this is not as a rule desirable, because so much barium enters the ileum that the cecum, ascending colon, and a part of the sigmoid are apt to be obscured. This can be avoided by restricting the amount of barium mixture in the container to 3 ounces.

Evacuation of the enema can be hastened by gentle abdominal massage.

Nineteen of the original group of 105 infants were returned at ages varying from three months to one year for follow-up study. This number is too small to permit conclusions. However, an effect of cathartics on the colon can apparently be seen even thus early in life, as demonstrated by the increased size of the lumen of the colon in comparison with infants not receiving such medication. The finding of an unusually large colon in several infants who did not receive cod-liver oil is of interest but not necessarily significant.

Redundancy of the descending and ascending colon and of the splenic and hepatic flexures was less marked in this older group, evidently due to longitudinal body growth. The cecum was found to be at the level of the iliac crest or higher in several of the infants who presented this same finding on the first examination, while in several other cases it had apparently descended from its previous higher position to the right iliac fossa.

Additional studies in infants under one year and in older children should be of value in tracing the further development of the colon.

NOTE: We take this opportunity to express our appreciation to Doctor George W. Grier for many helpful suggestions in carrying out this study; to Doctor E. S. Carey, former resident in radiology, for the invaluable assistance which she has given in making the examinations; to the x-ray technicians of the E. S. Magee Hospital, without whose loyal assistance this work would have been almost impossible.

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Clinical Aspects of Gastro-Intestinal Disease in Childhood[1]

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WHILE THE title of this paper is widely inclusive, I have selected for discussion certain conditions which are of especial interest in the field of gastro-intestinal disturbance in childhood. The conditions I have chosen have little relationship one to the other and I must be pardoned if I review much of what is already well known. The subjects seem to be of sufficient interest to bear an occasional review by all of us, whether radiologists or pediatricians.

CELIAC DISEASE OR CHRONIC INTESTINAL INDIGESTION

Celiac disease, or chronic intestinal indigestion, is a syndrome which occurs in young children, usually two to three years of age. It is of uncertain and possibly varied etiology. Aside from the instances in which cystic fibrotic disease of the pancreas is present, no etiology is known. The condition is characterized by malnutrition, a large distended abdomen, and abundant pale, foul stools which periodically become foamy and diarrheal. Neither fat nor carbohydrate is absorbed from the gut in a normal fashion, although both appear to be digested quite properly. The difficulty is one of absorption of properly digested food elements and the barrier appears to be a functional one at the intestinal mucosa. Nothing quite like this condition occurs in adult life, although sprue has some similar points.

As might be expected with any disease which profoundly interferes with nutritional processes, longitudinal growth is diminished and epiphyseal ossification is delayed. The appetite is poor. Distention of both the small and large bowel occurs, thus distinguishing the condition from Hirschsprung's disease. The distention is due to fermentation.

The patient is subject to infection, and this, of course, aggravates the malnutrition. Due to poor absorption the glucose tolerance test shows a flat curve. With glucose given intravenously the curve is also flat, but for a different reason, namely because the storehouses have been depleted. Once they are filled, a normal intravenous tolerance test is obtained.

The roentgenologist often sees clumping of barium as it progresses through the tract in an irregular disorderly fashion. This I believe was pointed out by Camp. One is also likely to see celiac rickets and osteoporosis, both related to the vitamin D deficiency to be expected when fat is so poorly absorbed.

Recently cystic fibrotic disease of the pancreas has been recognized as producing a clinical picture like celiac disease, and in the past many of these cases were so called. The distinction may be suggested clinically, for in fibrocystic pancreatic disease the onset is apt to be before the age of six months, the appetite is good, chronic pulmonary disease is likely to be present (due to cystic fibrosis in the lung as well), and a deficiency of pancreatic enzyme secretion may be demonstrable, although the methods of such demonstration are difficult. Whereas in celiac disease the prognosis is good, in fibrocystic pancreatitis it is usually bad.

HIRSCHSPRUNG'S DISEASE OR HYPERTROPHY AND DILATION OF THE COLON

Hirschsprung's disease, which was once regarded as a congenital malformation, is now thought to be due, usually, to a distal obstruction, either anatomical or functional. At first the sigmoid is in-

[1] From the Departments of Pediatrics and Radiology, University of California Medical School, San Francisco. Presented by Dr. Deamer before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

volved, later the entire colon. Among anatomical obstructions we must look for diaphragms or strictures, but these are usually not found. A kink at the recto-sigmoid juncture is apt to be secondary and not etiological. The usual cause of obstruction is faulty functioning of the neurological control of the region. Autonomic nervous system imbalance causes a spastic contraction ring at the recto-sigmoid juncture as well as loss of tone proximally. Other innervation defects, anatomical rather than functional, may also occur. Faber has shown absence of ganglion cells of the myenteric plexus in the lower colon. The situation of sympathetic-parasympathetic imbalance which brings about faulty function may be treated by lumbar sympathectomy or drugs of the mecholyl, prostigmine, or syntropan groups. Spinal anesthesia is a temporary measure used at times to forecast the results to be expected if sympathectomy is done. Bowel resection is becoming less frequent. Males outnumber females three or four times.

INTUSSUSCEPTION

One of the interesting things about intussusception is its tendency to occur in healthy male children under two years of age. Fifty per cent of the cases are seen between five and seven months. Three out of four are in males, and ileocecal in location.

The cardinal signs of intussusception are colicky pain, a mass in the abdomen, and a stool of blood and mucus, the so-called "currant-jelly" stool. Pain is sudden and accompanied by vomiting, restlessness, and pallor. The appearance is one of shock. There is no fever, the pulse is feeble, and the abdomen relaxed. A sausage-shaped tumor can usually be felt on the left side, and on rectal examination a cervix-like mass may be felt. This is the leading portion of the intussusception. On withdrawing the examining finger it is stained with blood.

Treatment is reduction either by enema or by surgery. Dr. Capp considers this subject in the discussion to follow (see p. 276).

If unrecognized, intussusception is usually fatal. The burden of diagnosis rests for the most part on the pediatrician or general practitioner who is first called. Recently a male infant was brought to our hospital, dead at arrival. He had been "treated" by telephone, by a physician, for gastro-intestinal infection of a type prevalent at the time. Autopsy showed complete obstruction and gangrene due to intussusception.

PEPTIC ULCER

Peptic ulcers in children, while not common, are certainly not rare. Seven cases were seen in our wards or in our clinic in the past two years. Five were in girls. Six were duodenal in location. One was recognized in a patient of ten, one in a patient of eleven. The rest were in children thirteen to fifteen years old. All the patients had pain and in addition usually tenderness, anorexia, anemia, nausea, or vomiting. Repeated abdominal pain severe enough to awaken a child should suggest ulcer. In one of our patients the complaint was fainting spells. The hemoglobin was 52 per cent, lowered by hemorrhage from the ulcer.

MECKEL'S DIVERTICULUM

As mentioned above, intussusception and Hirschsprung's disease have a decided tendency to occur in males. We know the same is true of pyloric stenosis. In Meckel's diverticulum we have a fourth condition which exhibits the same affinity for males. This condition, dependent on faulty evolution of the omphalomesenteric duct, is present in 2 to 4 per cent of all people. Although it usually remains symptomless, it may cause trouble by (1) invaginating and producing intussusception, (2) inflammation, simulating appendicitis save in location, (3) development of a bleeding ulcer. This last is the most common of the three complications. Its chief sign is bloody stool. Less often there is pain

near the umbilicus. The ulcer is usually found adjacent to some aberrant gastric mucosa in the wall of the intestinal tract at the site of the diverticulum.

RHEUMATIC ABDOMEN

It is not generally appreciated how often mild abdominal pain occurs in the course of rheumatic fever. At Babies' Hospital in New York, 19 out of 262 consecutive rheumatic patients, were admitted with the tentative diagnosis of appendicitis. This is more than 7 per cent. Ten of the nineteen were operated on; one had a clear-cut inflammation. During the subsequent course in the hospital, however, inflammation or kinking of the appendix developed in 2 per cent of the 262, for which operation was indicated. This illustrates the danger of temporizing in puzzling cases.

The one valuable differential test between rheumatic fever and appendicitis is the erythrocyte sedimentation rate, which is normal in acute appendicitis and very rapid in active rheumatic fever. Response to salicylates is also to be expected if the abdominal pain is rheumatic, but not if it is due to appendicitis.

The explanation of rheumatic abdominal pain is variable. It may be pain which is referred from the pleura, the pericardium, or the diaphragm. In other instances it may be due to rheumatic involvement of the abdominal muscles or the mesenteric lymph nodes.

MESENTERIC LYMPHADENITIS

The inflammation of intra-abdominal lymph nodes which accompanies some upper respiratory infections may also simulate appendicitis, although the pain is usually generalized and not localized. It is apt, also, to be colicky, recurrent, and to occur in repeated short attacks. The pathology of the condition is that of hyperplasia of mesenteric lymph nodes at the ileocecal junction and to a lesser extent in the mesentery of the lower ileum. While at times organisms can be cultured from these nodes, such attempts usually fail.

It is interesting to note that Brennemann, who was one of the first to point out how often this condition was confused with appendicitis, was also the first to warn against the reverse error, which as a result of his first paper was made more frequently and was much more serious. In other words, if in doubt, operate.

ABDOMINAL ALLERGY

Gastro-intestinal symptoms due to allergy are usually due to food allergy. They are associated with an amazingly varied list of symptoms, which include one or more of the following: fever, pain, vomiting, nausea, diarrhea, constipation, headache, dizziness, and ringing in the ears. These last will be recognized as components of the migraine syndrome. It seems unlikely that all migraine is due to allergy, but some of it unquestionably is.

Besides this variability of symptoms, barium meals and enemas containing allergenic foods have been shown to produce a variety of alterations in tone and motility of the digestive tract. Hypermotility as well as hypomotility may result. Especially frequent in these studies were spasms of the colon, hypomotility, and delayed emptying of the stomach. Something that is not generally appreciated is the fact that a food eaten daily may produce symptoms once every three weeks, or even once every six weeks.

The clinical pictures simulated by food allergy are numerous. One woman of our acquaintance underwent an appendectomy and later an exploratory abdominal operation for what were thought to be ulcer symptoms, but subsequently proved to be due to an allergy to milk.

We have touched briefly on a few interesting gastro-intestinal conditions of childhood which the radiologist may encounter. While many others could be added, the scope of this article does not permit their inclusion.

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DISCUSSION OF SYMPOSIUM ON THE GASTRO-INTESTINAL TRACT

(Papers by J. S. Bouslog; S. G. Henderson and W. W. Briant, Jr.; Wm. C. Deamer and C. S. Capp)

Joseph C. Bell, M.D. (Louisville, Ky.): Doctor Deamer has taken us back into the field of pediatrics, a field in which we should have at least a working knowledge, which I trust we have.

Hirschsprung's disease, or congenital megacolon, is always a condition of interest. It is my opinion that the diagnosis is made in some instances where organic pathology is not actually present. Many colons in children are large and hypotonic and resemble congenital megacolons quite closely when the bowel is distended with opaque material. In such cases, however, a film made after evacuation usually shows the bowel to be contracted. This does not take place in congenital megacolon. It is my opinion that the film made after evacuation is the most accurate factor in the roentgen examination in determining whether or not organic pathology is present.

I believe, in most instances, that the radiologist can determine whether or not an organic obstruction is present in the large bowel.

Disturbances in the small intestine of infants and young children are most interesting and unquestionably offer a large field for study, one that has been largely ignored until recently. Our knowledge is still far from complete but we are learning the characteristic roentgen-ray findings of the normal small bowel and coming to recognize some of the abnormal ones, such as those found in celiac disease.

Charles S. Capp, M.D. (San Francisco, Calif.): It is a very healthy sign when radiologists go back to fundamentals; that is, the gross and microscopic anatomy of the intestinal tract, to correlate these appearances with the pathologic conditions so frequently observed fluoroscopically and portrayed on the x-ray film. We must review from time to time just what a small bowel looks like not only in longitudinal section but in cross-section as well, particularly in the infant, and note the changes that occur as growth proceeds.

The anatomical position of the duodenum, in the infant, is practically always dorsal to the pyloric end of the stomach, and to see this structure properly the true lateral position must be used; further, as the infant is usually not examined in the erect position, some other positioning is necessary. If an adjustable foot rest be used in the elevated position, with the fluoroscopic table vertical, and the nurse-assistant hold the infant supported by the arms held close to the head, the buttocks resting on the foot rest, a fairly satisfactory examination can be made. This position during filming frequently aids in determining sites of congenital obstructions in the small bowel.

Doctor Bouslog stressed the point that air does not usually reach the rectum in the newborn infant until the twenty-fourth hour, particularly where there is an obstruction in the rectum. In addition to taking a film of the air-filled rectum with the head inverted (as shown on one of his slides), I find it an additional help to place a lead shot, held by adhesive tape, in the dimple of an imperforate rectum before filming. The distance between the air column in the rectum and the anal dimple aids the surgeon in deciding upon his operative procedure. Occasionally a fistulous connection can be demonstrated between the urinary tract and bowel in congenital defects of this type.

Doctor Henderson spoke of the sigmoid elongation as such a constant finding in infants that one oftentimes considers it as a normal condition. This elongation is not found with the same regularity or in so high a percentage of adults. It would be most interesting to be able to follow up infants showing this condition at a later period. I am still not satisfied just what it really means to have an elongated sigmoid or how many symptoms it may produce.

I think Doctor Henderson's method of insuring retention of the enema is rather ingenious. There is also the "Bardex Balloon" catheter, a double-barreled rubber tube, with one end blind but dilatable (used by the genito-urinary surgeons as a retention catheter). It can be used not only for the infant but for the adult who has lost rectal sphincter control.

Regarding intussusception, I have personally reduced successfully 6 out of 7 cases, 5 in males and 2 in females, by administration of a barium enema. In each case the ileum had invaginated into the cecum. The reduction was incomplete in one case, which was subsequently operated upon. As these cases were seen early (*i.e.*, within twenty-four hours) the reduction was possible before the bowel was too edematous.

F. E. Templeton, M.D. (Chicago, Ill.): I wonder if any studies have been made of distention, and whether there were any microscopic tests in the study of gastritis? What causes this distention? The mucosa or the submucosa?

Doctor Bouslog (*closing*): The sections shown are of the fetus and the child at birth. There was no distention of the tissues, since no air had entered the intestinal tract to distend them. Doctor Becker and his associates have described and demonstrated swallowing and reswallowing of meconium by the fetus and the passage of meconium through the gastro-intestinal tract. I question if this would produce any distention. The meconium was in the gastro-intestinal tract of the child at birth in these sections. The sections of the child ten days old did not show distention.

In regard to the duodenum—I have not been able to find any change in the size of the first, second, or third portion of the duodenum until about the second or third month after birth. The duodenum at birth is more like a tube. Doctor Henderson has been

doing similar work and I wish he would give his findings regarding the duodenum.

Doctor Henderson (*closing*): In reply to Doctor Bouslog's question about my own findings on the gastro-intestinal tract in the newborn, I have been able to demonstrate the duodenal cap or bulb in a large number of cases in infants between the second and tenth days of life. It appears very similar in shape to that which is seen in adults.

The question has been asked: "What is a normal colon?" I am compelled to say that I don't know. There have been several studies by different investigators on the supposedly healthy colon, but I think this question can be answered only through serial studies on the same group of infants and children over a period of several years. It is quite true that the sigmoid does tend to change its position in the abdomen from time to time, but this fact is not generally appreciated unless serial examinations are made.

In answer to Doctor Capp's question as to the length of time that the apparent elongation of the sigmoid persists, none of the children included in the present study have been examined after one year, and I am therefore not able to give any statistics at the present time.

Cancer in Childhood[1]

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According to the census (1), 153,846 persons died of cancer in the United States of America during the year 1939. Of these 1,103, or 0.7 per cent, were under fifteen years of age (Table I). The vital statistics of the Commonwealth of Massachusetts for the year 1939 show that the death rate for cancer in childhood was greater than for pertussis, pulmonary tuberculosis, measles, diabetes, cerebrospinal meningitis, syphilis, scarlet fever, or typhoid; while the only diseases which had higher death rates were "influenza," diseases of the nervous system, appendicitis, diarrhea and the enteric diseases, and pneumonia. Statistics from this source also indicate that during the past twenty-five years there has been an increase in the number of deaths from cancer in children, while in the case of many of the diseases common in infancy and childhood there has been a progressive decrease (Table II). Thus it is evident that cancer occurs with sufficient frequency in the young to occupy an important place in differential diagnosis. Moreover, these neoplasms are always of such serious prognostic import that they merit the most careful attention.

Table I: Deaths from Cancer and Other Malignant Tumors by Age and Sex (U. S. Census, 1939)

	Under 1 Yr.	1–2	2–3	3–4	4–5	5–10	10–15	Total under 15	Total All Ages
Male	46	51	63	58	38	174	176	606	72,416
Female	31	50	51	45	38	134	148	497	81,431
Total	77	101	114	103	76	308	324	1,103	153,846

Table II: Death Rates in Children under Fifteen Years in Commonwealth of Massachusetts

	1915	1920	1925	1930	1935	1939
Cancer	1.6	2.5	2.9	3.7	3.5	4.2
Pertussis	28.5	50.2	24.3	16.1	5.9	4.0
Pulmonary tuberculosis	20.0	14.8	8.7	6.6	3.5	2.7
Measles	14.2	31.5	30.2	11.5	3.2	1.3
Diabetes	3.8	3.7	1.6	1.0	0.9	0.9
Meningitis	9.4	8.2	2.1	3.2	2.8	0.9
Syphilis	9.6	6.6	4.3	2.8	1.6	0.7
Scarlet fever	16.4	17.3	8.3	7.1	3.8	0.7
Typhoid	2.7	1.4	1.4	0.5	...	0.2

Ewing (2) has pointed out the existence of a group of tumors seen particularly in infancy and childhood, among which the most notable are glioma of the retina, Wilms' tumor of the kidney, carcinoma of the liver, medulloblastoma, astrocytoma, malignant neurocytoma of the adrenal, lymphosarcoma of the testis, complex embryonal tumors of practically any organ, and teratogenous tumors of the cephalic or caudal extremities. He writes:

"As more detailed knowledge of the peculiar tumors of infancy and childhood accumulated, it became evident that in the first two decades of life, and especially up to the fifteenth year, there are many specific neoplastic diseases which are not encountered in later life. Furthermore, it is clear that the conditions of origin and the clinical course of these diseases are so peculiar that properly they may not be compared with any adult tumors, and that this entire subject deserves to be treated as a special department in the descriptive history of the neoplastic diseases. . . . It is now very well known that in the third decade cancer occurs rather fre-

[1] From the Department of Roentgenology and the Department of Pathology, Boston City Hospital. Accepted for publication in April 1942.

quently and does not differ materially from similar diseases in adult life. Real interest, however, attaches to the malignant neoplasms which occur in infancy and childhood up to 10 or 15 years, when special factors of heredity, nutrition, and growth may be expected to express themselves."

In discussing various previous surveys of this topic, Ewing indicates that there has been such a wide variation in the material of the different series of childhood neoplasms reported as to suggest that few institutions are observing a truly representative cross-section covering all forms of tumors in children.

It is the purpose of this communication to present a study which demonstrates the relative incidence of the malignant tumors of infancy and childhood as encountered in a large urban general hospital. To this end, we have collected all cases from birth through fifteen years of age in the records of the Boston City Hospital for the twenty-five year period from 1915 to 1939, inclusive. All available tissue sections have been reviewed and the histologic diagnoses confirmed or revised. Cases of Hodgkin's disease and leukemia were collected at the same time for purpose of comparison but are not included in our totals.

Although larger series of childhood tumors have been recorded (3, 4), those of Scotti (5) and Kellert (6) are included here for comparative study. Kellert's report comprises presumably all the cases from a single county (Schenectady, N. Y.) for an eleven-year period, and is considered representative of both rural and urban populations. Scotti's, from the New York Post Graduate Medical School and Hospital, is perhaps influenced by selective factors due to the proximity of other large medical institutions, particularly those specializing in cancer, diseases of children, or neurological conditions.

BOSTON CITY HOSPITAL CASES

In our study we found a total of 72 cases of malignant neoplasms. These were distributed as follows:

Intracranial	23
Eye and orbit	4
Kidney	13
Adrenal	2
Bone	11
Soft tissues	6
Skin and mucous membranes	5
Gastro-intestinal tract	2
Lung	1
Mesenteric nodes	1
Parotid	1
Thymus	1
Jaw	1
Retroperitoneal lymph nodes	1
Total	72

Intracranial Tumors: The malignant intracranial neoplasms numbered 23, or 32 per cent of the total of 72 cases. The types, locations, age, and sex distribution are indicated in Tables III and IV. In addition, there were found several histologically benign tumors, including a meningioma in a boy of four years, a papilloma of the choroid plexus in a girl of three years, a hemangioma of the cerebrum in a girl of seven years, and a pituitary adenoma in a girl of ten.

Eye and Orbit: There were 2 cases of retinal neuroblastoma, the left eye being involved in both instances. One occurred in a girl of five years; the other in a boy three years old. The third case involving the eye was a retinoblastoma in a boy two years of age.

The sole orbital tumor was a malignant teratoma on the right, in a month-old girl; this neoplasm had been present since birth.

Kidney: Renal tumors comprised the second largest group, numbering 13 or 18 per cent of the total. One, an embryonal carcinoma of the left kidney, occurred in a girl one year old. The remaining 12 were Wilms' tumors. Two involved the right kidney and 10 the left. The youngest patient in this group was one year of age and the oldest ten years. Five were boys and 7 girls.

Adrenal: There were 2 cases of neuroblastoma of the retroperitoneal tissues, presumably primary in the adrenals or sympathetic chain. Both were in girls. The ages were four and five years.

Bone: It is of particular interest that the bone tumors, numbering 11, were all

TABLE III: MALIGNANT TUMORS IN CHILDHOOD: SUMMARY OF BOSTON CITY HOSPITAL CASES AND COMPARISON WITH SERIES OF SCOTTI AND KELLERT

Boston City Hospital			Scotti's Series			Kellert's Series		
INTRACRANIAL		23	INTRACRANIAL		9	INTRACRANIAL		2
Gliomas			Glioma (cerebellum)	6		Glioma	2	
Medulloblastoma	8		Glioma (cerebrum)	1				
Astrocytoma	6		Astrocytoma	1				
Mixed glioma	4		Cyst (third ventricle)	1				
Medullo-epithelioma	1							
Craniopharyngioma	1							
Malignant tumors, possibly metastatic	3							
EYE		3	EYE		12	EYE		1
Neuroblastoma	2		Retinoblastoma	12		Gliosarcoma	1	
Retinoblastoma	1							
ORBIT		1						
Malignant teratoma	1							
RENAL		13	RENAL		16	RENAL		2
Wilms' tumor	12		Wilms' tumor	13		Adenosarcoma	1	
Embryonal carcinoma	1		Carcinoma	3		Carcinoma	1	
ADRENAL		2	ADRENAL		4	ADRENAL		4
Neuroblastoma	2		Neuroblastoma	4		Neurocytoma	3	
						Carcinoma	1	
BONE		11	BONE		9	BONE		3
Osteogenic sarcoma	7		Osteogenic sarcoma	2		Osteogenic sarcoma	1	
Ewing's sarcoma	4		Periosteal sarcoma	2		Ewing's sarcoma	1	
			Ewing's sarcoma	2		Giant-cell sarcoma	1	
			Fibrosarcoma	2				
			Giant-cell sarcoma	1				
SOFT TISSUES		6	SOFT TISSUES		8	SOFT TISSUES		2
Synovial sarcoma (popliteal space)	1		Lymphosarcoma (retro-peritoneal)	5		Fibrosarcoma (sole of foot)	1	
Fibrosarcoma (antrum)	1		Teratoma (mediastinum)	1		Myxosarcoma (retroperitoneal)	1	
Fibrosarcoma (calf)	1		Liposarcoma or thymoma	1				
Leiomyosarcoma (scalp)	1		Fibrosarcoma (pharynx)	1				
Undifferentiated malignant tumor (buttock)	1							
Hemangio-endothelioblastoma (abdominal wall)	1							
SKIN AND MUCOUS MEMBRANES		5						
Amelanotic melanocarcinoma (ankle)	1							
Melanoblastoma (forearm)	1							
Basal-cell carcinoma (arm)	1							
Carcinoma (gum and buccal mucosa)	1							
Undifferentiated carcinoma (antrum)	1							
GASTRO-INTESTINAL TRACT		2						
Scirrhous carcinoma (stomach)	1							
Adenocarcinoma (colon)	1							
LUNG		1						
Epidermoid carcinoma								
LIVER			LIVER		2			
			Carcinoma	2				
UTERUS						UTERUS		1
						Carcinoma (cervix type)	1	
OVARY			OVARY		2			
			Carcinoma	2				
THYROID			THYROID		1			
			Carcinoma	1				
MESENTERIC NODES		1						
Metastatic carcinoma								
PAROTID		1						
Adenocystoma lymphomatosum with squamous-cell carcinoma								
THYMUS		1	THYMUS		1			
Thymoma			Carcinoma	1				
JAW		1						
Plasmocytoma								
RETROPERITONEAL NODES		1						
Hodgkin's sarcoma								
TOTAL		72			64			15

TABLE IV: INTRACRANIAL TUMORS: 23 CASES

Type of Tumor	Sex	Age	Location
Medulloblastoma (8 cases)	M	1 yr.	Cerebellum (vermis)
	M	16 mo.	Cerebellum (mid-line)
	F	18 mo.	Cerebellum, pons, midbrain, medulla
	M	2 yr.	Cerebellum (mid-line)
	M	5 yr.	Cerebellum (both hemispheres)
	M	6 yr.	Pons
	F	7 yr.	Roof of fourth ventricle, over medulla
	M	10 yr.	Within fourth ventricle, from roof at upper end
Astrocytoma (6 cases)	F	5 yr.	Medulla and pons
	M	6 yr.	Medulla (left olive), cerebellar tonsil, base of brain
	M	6 yr.	Right frontal lobe (parolfactory area); 6-mm. pedicle
	F	6½ yr.	Cerebellum (right hemisphere) and brain stem. Contained a large cyst
	M	8 yr.	Left frontal lobe (deep, between sylvian and rolandic fissures)
	F	12 yr.	Cerebellum (vermis); cystic
Mixed Glioma (4 cases)	M	9 yr.	Pons and medulla. Polar spongioblastoma with medulloblasts and astrocytes
	M	12 yr.	Medulla, left superior portion and fourth ventricle. Astrocytoma and glioblastoma multiforme
	F	13 yr.	Left cerebrum, deep in white matter. Oligodendroglioma with medulloblasts and astroblasts
	M	13 yr.	Left parietal lobe and ventricle. Ependymoma and glioblastoma multiforme
Other Primary Intracranial Tumors (2 cases)	F	20 mo.	Right cerebellopontine angle. Medulloepithelioma
	F	4 yr.	Overlying sella. Craniopharyngioma
Possibly Metastatic Intracranial Tumors (3 cases)	F	13 yr.	Left cerebrum (base). Undifferentiated, possibly metastatic carcinoma
	M	14 yr.	Cerebellum. Malignant spindle-cell tumor, possibly metastatic
	F	14 yr.	Sella and sphenoidal region. Carcinoma, presumably metastatic

sarcoma of the osteogenic and Ewing types. The youngest patient was seven years of age; most of the cases occurred in children of thirteen to fifteen years. The sex distribution was practically identical. See Table V.

TABLE V: BONE SARCOMA: 11 CASES

Type	Sex	Age (Yr.)	Location
Osteogenic sarcoma (7 cases)	M	11	Left tibia
	F	11	Right femur
	M	15	Left shoulder
	M	13	Left femur
	M	14	Left rib
	F	14	Right femur
	F	15	Right femur
Ewing's sarcoma (4 cases)	M	10	Left tibia
	F	15	Sacrum
	M	13	First right metatarsal
	M	7	Right humerus

Soft Tissues: This group totalled 6. Of 4 sarcomas, 3 were in the pre-sexual age group, only one in an infant. See Table VI.

TABLE VI: TUMORS OF SOFT TISSUES: 6 CASES

Sex	Age (Yr.)	Type	Location
F	15	Synovial sarcoma	Left popliteal space
M	15	Fibrosarcoma	Left antrum
M	2	Fibrosarcoma	Calf of right leg
F	11	Leiomyosarcoma	Scalp
M	14	Undifferentiated	Buttock
F	14	Hemangio-endothelioblastoma	Anterior abdominal wall

Skin and Mucous Membranes: There were 5 tumors of the skin and mucous membranes. Of the 2 cases of melanoma and 1 basal-cell carcinoma, all were in the pre-sexual period. Two cases of carcinoma, of the mouth and antrum, occurred in early childhood. See Table VII.

TABLE VII: TUMORS OF SKIN AND MUCOUS MEMBRANES: 5 CASES

Sex	Age (Yr.)	Type	Location
F	14	Amelanotic melanocarcinoma	Left ankle
F	11	Melanoblastoma	Right forearm
F	12	Basal-cell (hair matrix) carcinoma	Right upper arm
M	7	Undifferentiated carcinoma	Right antrum
M	3	Rapidly growing malignant tumor, probably carcinoma	Gum and buccal mucosa

Gastro-intestinal Tract: There were 2 cases in this group. One was an adenocarcinoma of the descending colon in a girl of fifteen years and the other a scirrhous carcinoma of the stomach in a girl of twelve.

Lung: An epidermoid carcinoma of the right lung was found in a boy of nine.

Mesenteric Nodes: There was 1 neoplasm involving the mesenteric nodes, a metastatic carcinoma in a boy thirteen years of age.

Parotid: We encountered but 1 cancer of the parotid, an adenocystoma lymphomatosum with what appeared to be slowly growing squamous-cell carcinoma, in a girl fourteen years old.

Thymus: There occurred 1 thymoma. The patient was a seven-year-old girl.

Jaw: A biopsy of the jaw of a boy of twelve revealed plasmocytoma. No autopsy was done and the primary site could not be determined.

Retroperitoneal Lymph Nodes: One neoplastic growth involving the retroperitoneal lymph nodes was found, a Hodgkin's sarcoma. The patient was a boy fifteen years of age.

Hodgkin's Disease and Leukemia. We found, in addition, 11 cases of Hodgkin's disease (other than sarcoma) and 27 of leukemia in children, during the same twenty-five-year period. Of the 27 cases of leukemia, 24 were of the lymphatic type, 2 myelogenous, and 1 monocytic.

A statistical study has been made of all malignant neoplasms in children from birth through fifteen years of age observed at the Boston City Hospital for the twenty-five year period, 1915 to 1939, inclusive.

In this study a total of 72 cases was collected. The largest group was that of intracranial neoplasms, which numbered 23, or 32 per cent of the entire series. Tumors of the kidney comprised the second largest group, numbering 13, or 18 per cent.

During the same twenty-five year period, there occurred 11 cases of Hodgkin's disease (other than sarcoma) and 27 of leukemia.

The commonest tumors were glioma (medulloblastoma, astrocytoma, and mixed gliomas), Wilms' tumor, osteogenic and Ewing's sarcoma, and miscellaneous soft-tissue sarcomas. There were 3 examples of carcinoma of the adult type.

The relatively small number of cases of neuroblastoma of the adrenal is in marked contrast to the findings in previously reported series.

Among the earliest instances of cancer were a Wilms' tumor at one year, medulloblastoma in patients one and two years of age, and a fibrosarcoma at two years.

The only congenital tumor in the series was a malignant teratoma of the orbital region.

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SUMMARY

Childhood deaths (*i.e.*, under fifteen years of age) from malignant tumors comprise 0.7 per cent of all deaths from cancer.

During the year 1939, there were in Massachusetts more childhood deaths from cancer than from any of the following diseases: pertussis, pulmonary tuberculosis, measles, diabetes, cerebrospinal meningitis, syphilis, scarlet fever, and typhoid.

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The Value of Roentgen Rays in the Diagnosis of Endocrine Diseases

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IN THE PRESENT-DAY diagnosis of endocrine disorders, careful attention is given to the patient's family, prenatal, postnatal, and present history, laboratory and biochemical studies are made, and anthropometry is employed. Roentgen-ray examination is the most useful aid in diagnosis, since skeletal growth and development constitute one of the basic evidences of endocrine status in children as well as in adults. The thyroid and pituitary are the glands principally concerned. The formation, growth, and alignment of bones take place with regularity, beginning in the fetal state and continuing through different epochs after birth. Departure from the normal on the part of the ossifying centers or the epiphyses denotes a disturbance of one or more of the endocrine glands. Roentgen examination of the bony framework and structure in infants and children is therefore of the utmost importance; it is, in fact, a necessity, as it may be the only method of diagnosing endocrine disease.

Engelbach, in his *Endocrine Medicine*, gives an excellent account of the osseous development from birth to, and including, twenty years of age, with accompanying roentgenograms. In the first forty-eight hours after birth, the centers of ossification in the knee, lower end of the femur, upper end of the tibia, the astragalus, calcaneus, and cuboid bones in the foot, should be demonstrable roentgenographically. Should one or more of these centers be absent at birth, the chances are that thyroid deficiency is present, especially if the child is over-weight (nine pounds or more).

Roentgen examination furnishes direct evidence for the differential diagnosis of endocrine diseases. It is useful in the diagnosis of pituitary, thyroid, adrenal, parathyroid, gonadal, and thymic disturbances, whether in the form of hypoactivity or hyperactivity. It is important, also, for the differentiation of non-endocrine from endocrine diseases: rickets from achondroplasia, osteitis deformans from osteogenesis imperfecta due to hyperparathyroidism, multiple myeloma from hyperparathyroidism, osteopetrosis or marble bones from osteomalacia.

Acromegaly: In the adult acromegaly is diagnosed by roentgen examination of the sella turcica. With an adequate history and roentgen studies the diagnosis can be made in its earlier stages. Roentgenograms show increase in size of the frontal and occipital protuberances, prognathism, increase in size of the sinuses, thickening and over-growth of the malar bones, enlargement of the feet, hands, and skull, and broadening of the metacarpals and phalanges; the distal phalanges show lipping and tufting, and the long bones may be increased in width. In extreme cases there are weakness, headaches, constipation, and loss of libido. If the pituitary tumor is eroding in a downward direction, there may be destruction of the floor of the sella turcica; if it is eroding anteriorly or posteriorly, destruction of the anterior and posterior walls of the sella and the clinoid processes may be observed. The cranial vault shows over-growth and increased thickness and there is also over-growth of all flat bones. The acromegaly of adolescence is of a different type. Growth is accelerated at an early age, but disturbances of the sella may not be demonstrable.

Gigantism: Anthropometry is necessary for the diagnosis of gigantism. In the eunuchoid giant the lower measurements

[1] Read before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

(pubis to floor) are greater than the upper measurements (pubis to crown) and the span is greater than the height; whereas in the normal giant (six feet six inches or over) the lower measurements are the same as the upper and the span is equal to or less than the height. Roentgen examination may offer decisive evidence in differentiation of primary and secondary gigantism. A small, fully enclosed sella is highly suggestive of gigantism of the eunuchoid type, while a wide or eroded sella conclusively proves a primary pituitary origin. In primary gigantism there are large frontal sinuses, thickening of the skull, overgrowth of the frontal, malar and occipital protuberances, broadening of the metacarpals and phalanges, with tufting and lipping of the distal phalanges; the flat bones may also show broadening, which is an early indication of acromegaly. Such cases are classed as hyperpituitary. In the hypopituitary type, the roentgen ray discloses a delay in the appearance of the ossification centers and closure of the epiphyseal lines; examination of the sella may reveal bridging of the clinoids and the frontal sinuses may be absent.

Dwarfism: Dwarfism is of two types, endocrine and non-endocrine. Endocrine dwarfism may be of pituitary or thyroid origin. *Pituitary dwarfism*, commonly called Lorain-Levi dwarfism or infantilism, is not usually accompanied by mental retardation and the features are not those of childhood myxedema or hypothyroidism. In this group, it is thought, there is a deficiency of the growth hormone and the gonadotropic hormone, causing a retardation of growth of the long bones and delayed genital development. The chief signs are: height which is below the average, four and one-half feet or less; small features; soft silky hair; small feet and hands with tapering fingers; infantile, genitalia, and usually retardation of osseous development. The bones are thin and ossification and epiphyseal closure are delayed. The sella may be bridged or there may be a pituitary tumor; the teeth are undersized and distorted.

Thyroid dwarfism is due to a lack of thyroid hormones and is of two types, cretinism and childhood myxedema. Cretinism is congenital, whereas myxedema develops after birth. Since these two conditions cannot be differentiated by roentgen examination, they will be considered together for the purposes of this discussion. Thyroid dwarfs show delay in growth, in walking, dentition, and talking; there may be some mental retardation; the skin and hair are dry. Some have large thick tongues, some have pot bellies, and some have short stubby fingers. In all of these types the roentgenograms show a marked delay in ossification and closure of the epiphyses. Fortunately, modern medicine is making progress in the prevention as well as the cure of these hypothyroid states. Administration of iodine and thyroid preparations to the pregnant woman may mean a normal baby instead of a large, over-weight, hypothyroid child. In adult hypothyroidism roentgen examination may show increased density of the bone due to the retention of calcium. Roentgen examination of the intestinal tract with the aid of a barium meal often shows spasticity and atonicity of the colon revealed as spastic constipation. In severe hypothyroidism the heart is very large and broad, often described as "flask-shaped." Films made after thyroid medication may show a return to normal shape and size.

There are four types of *non-endocrine dwarfism:* achondroplasia, rickets, scurvy, renal rickets or renal dwarfism.

The onset of achondroplasia is in early fetal life. The cartilaginous development is disturbed, with abnormal epiphyseal growth, especially of the long bones. The flat bones are affected very little if at all. Dwarfs of this type have a normal trunk or body, shortened extremities, and a disproportionately large head. They are mentally alert and usually congregate together, joining circuses and sideshows, and attaining economic independence. Roentgen examination may show the classical bulging of the radius.

In early rickets, roentgen-ray examina-

tion shows swollen, inflamed epiphyses, which may not be calcified. Irregularity of the diaphyseal margin is moderately advanced and there is flaring of the diaphyseal ends or cupping; the shafts of the bone are widened at the epiphyseal ends, and marginal elevation of the periosteum and bending of the shafts are observed. The blood phosphorus is reduced.

Scurvy is less rare than we are led to believe. A colleague of mine saw a child with a stomatitis which failed to heal in spite of treatment, associated with an ulcer of the mucous membrane of the cheek. Noticing that the child cried out when it was handled or pressure was exerted on the leg and arm, he immediately made films and found a raised periosteum and subperiosteal hemorrhage, with the white lines of Fraenkel at the ends of the shafts. Orange juice and large doses of vitamin C completely cured the ulcer and painful bones.

Cardinal signs of renal rickets or renal dwarfism are genital infantilism, polyuria, and dilatation of the urinary tract, usually with the development, sooner or later, of nephritis. The retrograde pyelogram shows enlarged dilated ureters and distorted calyces. It is thought that faulty mineral metabolism causes a faulty bone growth and may affect the kidneys. There is delay in osseous development and epiphyseal closure.

Simmonds Disease: Simmonds disease is characterized by general debility and cachexia. It is due to complete destruction of the cells of the anterior lobe of the pituitary. Roentgen examination of the sella turcica is usually negative, but in some cases there are enlargement and erosion from tumor, or the sella may be extremely small. Roentgen examination of the abdominal viscera with a barium meal shows splanchnomicria with atony and ptosis of the viscera.

Cushing's Syndrome: Cushing's syndrome is manifested by masculinization, adiposity, stunted growth, cutaneous purplish striations on the abdomen and thighs, hirsutism, and hypertension. It is in most cases found in young women. It may be due to any of three pathological entities: (1) adenoma of the basophilic cells of the anterior pituitary, (2) tumor of the adrenal cortex, (3) arrhenoblastoma of the ovaries. Roentgen examination is useful but at times shows only decalcification or osteoporosis of the bones, especially of the vertebrae. Multiple renal calculi may be found as a result of excessive calcium excretion. The sella turcica should always be examined for a possible eroding tumor. Injection of air in the perirenal tissues is useful for demonstration of the adrenal glands, and retrograde pyelograms may show displacement of the kidney by tumor.

Hyperthyroidism: The roentgen ray is of little value in the diagnosis of hyperthyroidism. In long-standing cases, however, it may show osteopetrosis and often osteomalacia. A substernal thyroid may be demonstrable roentgenographically.

Addison's Disease: The adrenal glands should be studied roentgenologically in all cases of Addison's disease. Examination of the kidney region may reveal calcification of the adrenals from an unrecognized tuberculosis.

Hyperadrenalism: In hyperadrenalism, distortion or malposition of the kidney is revealed by the retrograde pyelogram. The method, as described by Cahill and others, of introducing 200 to 250 c.c. of filtered air into the perirenal space is useful when pictures are to be taken over a period of eighteen to twenty-four hours. The area surrounding the adrenals shows a clear outline; enlargement may be disclosed and adhesions, if present, cause failure. In bearded women of male type, or those with hirsutism, an enlarged clitoris, hypertension, and pigmentation of the areola of the breast, examination of the adrenal glands with the aid of air injection in the perirenal space and retropyelography should be more frequently employed.

Hyperparathyroidism: Hyperparathyroidism manifests itself in its effects on the bony framework. Three groups are usually recognized: (1) decalcification of the bones

resulting in cystic tumors and fractures, usually through the cysts; (2) an osteoporotic type showing a marked general decalcification of all the bones, sometimes associated with cysts and tumors but less frequently than the first type, (3) a type manifested by renal symptoms, with roentgen evidence of stones in the kidney, urinary bladder, and gallbladder, and even calcified areas in the lung. The kidney stones, if large, lead to renal insufficiency. The vertebral column may show marked decalcification, resulting in kyphosis or scoliosis or both. The picture may be that of "accordion spine," or collapse of the vertebral bodies and expansion of the intervertebral discs may produce the so-called "fish-spine," with a reduction in the superior and inferior diameters. A diagnosis cannot, of course, be made exclusively on the basis of the roentgen examination, for one of the chief signs in all types of hyperparathyroidism is the high blood calcium level, with a low phosphorus and high phosphatase level. The normal plasma calcium is 9 to 11 mg. per 100 c.c. of blood, but in the presence of a hyperactive parathyroid the figure may rise to as high as 12 to 20 mg. The plasma phosphorus may decrease from a normal of 2.5 to 5 mg. per 100 c.c. to as low as 1.0 mg. The blood phosphatase, normally 4 Bodansky units, may be increased to 12 to 20 Bodansky units.

Schüller-Christian Syndrome: In this syndrome there is marked decalcification of the bones, especially of the skull. Exophthalmos may be unilateral, as a result of softening of the orbital bones and pressure from postorbital infiltration. Bony defects are also noted in the jaw, ilium, femur, humerus, ischium, and, at times, in the scapula, ribs, and vertebrae.

Osteitis fibrosa disseminata: Hyperparathyroidism must be differentiated from osteitis fibrosa disseminata, described by Albright and his associates. This latter syndrome consists in bone lesions, with a marked unilateral tendency, showing fibrous osteitis with cyst formation, areas of brown, non-elevated pigmentation in the skin, usually on the same side as the bone lesions, and endocrine dysfunction associated in the female with precocious development and in the male with a tendency to delayed sexual development. The roentgen ray reveals a variety of bone lesions rather than any one specific type. The skeletal abnormalities are spotty in distribution, with multiple localized lesions and areas of normal bone. There is no generalized skeletal decalcification. Cysts may be present in the medulla and the cortex of both the long and flat bones. The epiphyses often escape involvement even when the entire shaft is involved. Roentgen studies of the skull may show irregular calcium deposits and cysts, suggestive of Paget's disease.

Paget's Disease: Some endocrinologists attribute the obesity and defective carbohydrate metabolism in Paget's disease to pituitarism. A high incidence of associated endocrine disorders has been reported in patients with Paget's disease and their families (Maebling and Murphy). The parathyroids probably play only a secondary rôle. The early occurrence of a high blood phosphorus, as suggested by Bodansky and Jaffe, has led to the belief that Paget's disease may be detected thereby, making possible discovery of the osseous dystrophies before too much damage is done. Roentgen examination must, of course, be the final diagnostic test. The "woolly" appearance of the bones in the skull and of the pelvis is a characteristic feature. There may also be a loss of calcium in the pubic bones, iliac bones, and old fractures of the ribs.

Mongolism: There is seldom any doubt as to the diagnosis of mongolian idiocy. The slanting eyes, flattened nose, large thick tongue that may completely fill the mouth, and other congenital defects are typical. Roentgen ray may reveal retardation of osseous development and epiphyseal closure.

Other osseous disturbances, such as osteopetrosis or marble bones, osteogenesis imperfecta, and multiple myeloma, are of non-endocrine origin. In multiple myeloma

the diagnosis is made by examining the urine for Bence-Jones protein.

Pineal Gland Disturbance: Disturbances of this type are found more frequently in the male and show themselves in early sex development and precocity. Regardless of the actual cause, the expression is a state of testicular over-activity. Early sex development is evidenced by erections, ejaculations, pubic hair, voice changes, and early closure of the epiphyses, retarding skeletal development. The diagnosis is based on hypergenitalism, complete ossification of all the growth centers, and closure of the epiphyseal lines.

Hypogonadism: Hypogonadism of the adolescent type is disclosed roentgenologically by delay in epiphyseal closure of the long bones.

Enlargement of Thymus Gland: The thymus gland can be demonstrated only by x-ray. Internists and pediatricians have said that they could discover an enlarged thymus by percussion but it is always left to the roentgen ray to demonstrate the enlargement.

It is impossible in so brief a paper to cover completely the roentgen-ray findings of all glandular disturbances. The important point is to realize the fact that endocrine disturbances do occur and that they are diagnosed for the most part by roentgen examination, especially in their osseous manifestations. The time has arrived when one must know something about endocrinology in whatever branch of medicine he is primarily interested. Endocrine disturbances occur in all classes, in all walks of life, and many tragedies are attributable to failure to make an early diagnosis.

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The Roentgenographic Appearance of the Bones in Cushing's Syndrome[1]

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A SERIES OF 7 cases of Cushing's syndrome from the records of the Mount Sinai Hospital was studied with particular attention to the occurrence, appearance, and distribution of osteoporosis. The final diagnosis in 4 cases was carcinoma, and in 3 cases adenoma, of the adrenal cortex, as proved at operation or at autopsy. All of the patients were females.

TABLE I: ROENTGEN FINDINGS IN SEVEN CASES OF CUSHING'S SYNDROME (ALL IN WOMEN) ASSOCIATED WITH AN ADRENAL CORTEX TUMOR*

Case	Age	Skull	Spine	Ribs	Long Bones	Perirenal Air Studies	Pathology
1. M. R. 401,942	34	+	−	−	..	+	Carcinoma. No metastases discovered postmortem
2. A. G. 402,810	34	−	+	+	..	+	Adenoma
3. M. K. 463,553	49	+	−	−	−	Mass with calcification	Carcinoma
4. E. I. 454,649	19	−	−	−	−	Mass displacing kidney	Carcinoma. Metastasis to right lung?
5. V. B. 435,550	30	+	+	+	+	+	Adenoma. Large pituitary gland, but no adenoma
6. A. R. 446,906	37	+	+	+	−	Large mass	Carcinoma. Metastasis to liver and lungs
7. E. S. 480,411	37	+	+	+	+?	?	Adenoma

* A plus sign indicates the presence of roentgen changes; a minus sign normal roentgen findings.

The characteristic clinical picture of Cushing's syndrome in the female, in whom most of the cases have been reported, is the deposition of fat on the trunk, vascular hypertension, amenorrhea, the development of purplish striae on the abdomen, choleric facies, varying degrees of hirsutism, acneiform eruptions on the face and trunk, decreased sugar tolerance, and osteoporosis. The syndrome apparently occurs with basophilic adenoma of the pituitary gland, tumors of the adrenal cortex and, very rarely, of the thymus, or without tumors of any of these organs (2). The association of a tumor with Cushing's syndrome occurs rarely in the adult male, regularly in the child, and commonly in the adult female (2). In all cases the basophilic cells show characteristic hyaline changes which are now regarded as the common pathological denominator (2). It may be, however, that the hyalinization represents the degenerative change following a period of overactivity of the basophils as a consequence of inactivation of certain subsidiary ductless glands (6).

There is a decrease or absence of estrogens in the blood, and an increase in the urinary androgens. Androgens may inhibit the effect of the estrogens on the formation of bone, and this may account for the severity of the osteoporosis. The most important factor, however, is thought to be a negative nitrogen balance due to the increased conversion of proteins into sugars (1).

Osteoporosis occurs frequently in Cushing's syndrome. Eisenhardt and Thompson (4), in a review of the literature, found that of 61 patients, ranging in age from eleven to seventy-eight years (average thirty-four years), in whom an examination of the bones had been made, 53 had definite osteoporosis, 5 showed questionable changes, and 3 had normal bones.

[1] From the Department of Radiology, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in May 1942.

In one of the 53 cases with osteoporosis there was delayed epiphyseal union. In our series of 7 patients, from nineteen to forty-nine years of age, 6 had osteoporosis. The skull was involved most often in our cases, but the more striking changes occurred in the spine and in the ribs. In one patient with severe changes, the long bones, especially the femora and the humeri, were involved.

The osteoporosis in the skull, noted in 5 of the 7 cases, was irregular in distribution and occurred most often in the frontal and parietal regions. The osteoporotic areas were irregularly triangular or ameboid in shape, with ill-defined margins, or were roughly circular, resembling metastatic cancer. In one case (Fig. 4) there was diffuse, slightly coarse granular mottling of the calvarium not unlike that observed in a well advanced case of hyperparathyroidism. Occasionally, only the dorsum sellae was osteoporotic.

The osteoporosis of the spine was uniform and was found in all segments. The bones were more radiolucent because of a uniform decrease in the number and density of the trabeculae. In an occasional case the osteoporosis was barely perceptible; again it was so severe that compression fractures occurred in the vertebral bodies (Fig. 1). No characteristic features were observed which would differentiate it from osteoporosis of the spine from any other cause.

A most interesting, almost pathognomonic finding was a peculiar appearance near the costochondral junctions, usually in the lower ribs, and as a rule symmetrically situated on both sides (Fig. 2). The ribs just proximal to the costochondral junctions were expanded to about twice their normal diameter for a distance of about an inch. This area was sharply outlined as though by a calcified shell. Within this, the calcium salt deposition was uniform and homogeneous. These areas were much denser than the surrounding bone and suggested callus formation. In our cases no fracture line was demonstrable. In one of Wilson's cases (3, 7), however, in which the diagnosis was not proved, recent fracture lines were noted. The histologic picture in one of our cases was indistinguishable from callus (5). The fractures of the vertebral bodies are readily explained as a result of decreased strength due to osteoporosis. While this same reason may be given for the occurrence of rib fractures, it may be significant that they have not been recorded with osteoporosis occurring after the menopause or following nutritional disturbances. In the cases of postmeno-

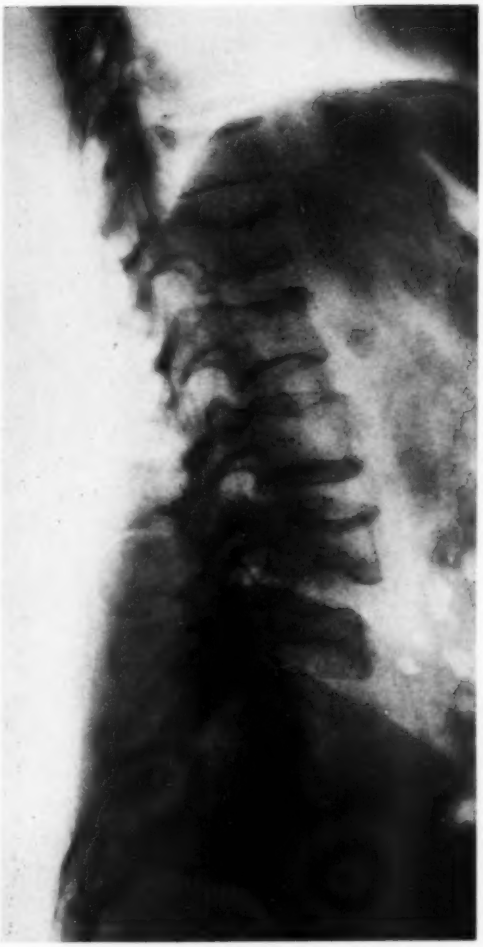

Fig. 1. From a case of adenoma of the adrenal cortex. Severe osteoporosis and compression fractures of the vertebral bodies. This patient (No. 5 in the table) also had osteoporosis of the long bones.

pausal osteoporosis reported by Albright, Smith, and Richardson, there was a history of rib fractures in only one instance (No. 34). Furthermore, not one of our patients complained of chest pain, though it must be admitted that roentgen evidence of fracture, especially in elderly people, is sometimes unassociated with pain.

and parietal regions, and are irregularly triangular or ameboid in shape, or may resemble malignant metastases. The osteoporosis in the spine is uniform in degree and extent. The trabeculae are decreased in number and density. The osteoporosis may vary, from case to case, from barely perceptible changes to those of such severity that compression fractures occur

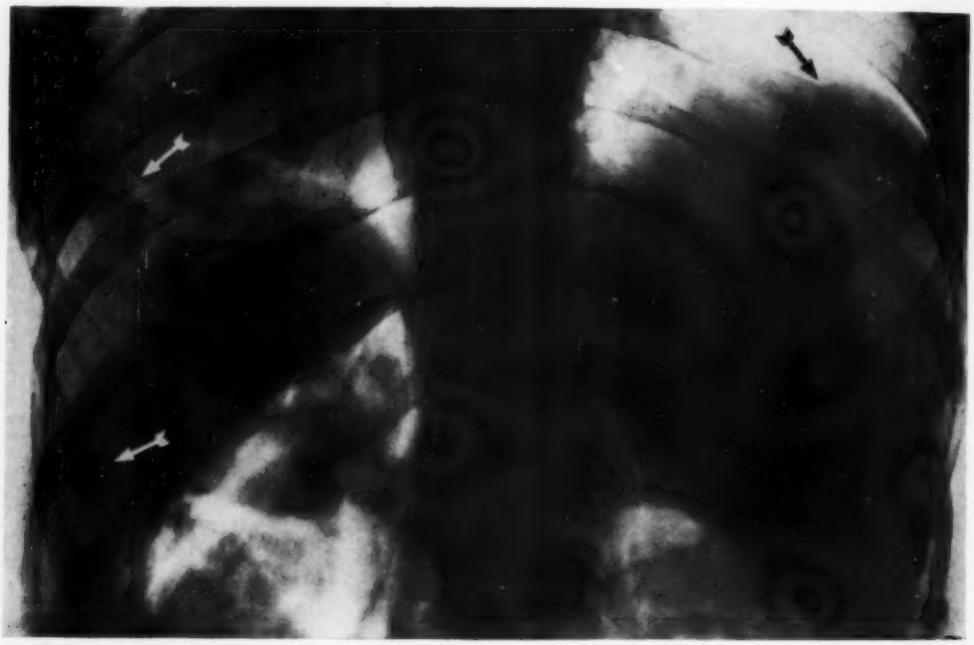

Fig. 2. Same case as Fig. 1. Note the peculiar callus-like bilateral changes near the ends of the ribs.

In one case in which the osteoporosis was extreme, the humeri and femora were also osteoporotic.

The more profound changes occurred in the cases of adenoma. The duration of the illness, as judged from the onset of symptoms, could not be correlated with the severity of the changes observed in the bones.

SUMMARY

Osteoporosis occurs frequently in Cushing's syndrome (in 6 of our 7 cases). In the skull, which is most often involved, the changes are irregularly distributed; they are seen most often in the frontal and parietal regions, and are irregularly triangular or ameboid in shape, or may resemble malignant metastases. The osteoporosis in the spine is uniform in degree and extent. The trabeculae are decreased in number and density. The osteoporosis may vary, from case to case, from barely perceptible changes to those of such severity that compression fractures occur in the vertebral bodies. A peculiar change is described in the anterior ends of the lower ribs just lateral to the costochondral junction; the rib is expanded to about twice its normal size for a distance of an inch, and is homogeneously increased in density. These areas cannot be distinguished from callus either roentgenographically or histologically.

By far the greatest number of cases of Cushing's syndrome reported in the literature have an associated basophilic pituitary adenoma. In all of our cases there was a tumor of the adrenal cortex, in some a benign adenoma, and in others a carcinoma.

Fig. 3. A diagnosis of basophilism was made in this case (No. 7 in the table) in 1939. The skull was normal at that time.

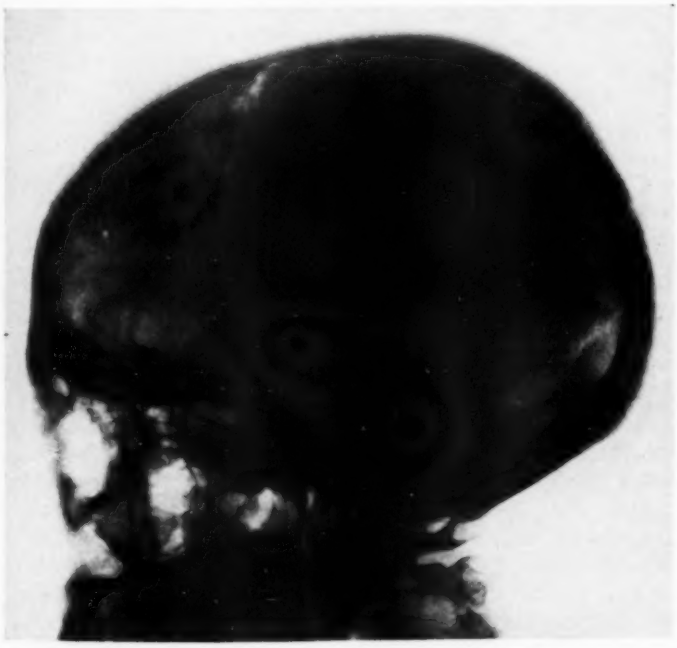

Fig. 4. Same case as Fig. 3. The skull in 1941 shows diffuse osteoporotic mottling, particularly in the frontal bone. Shortly after this examination was made, an adrenal cortical adenoma was removed at operation.

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Results of Irradiation Treatment of Cancer of the Lip: Analysis of 636 Cases from 1926–1936[1]

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A SURVEY OF THE records of the State Institute for the Study of Malignant Diseases from Jan. 1, 1926, to Dec. 31, 1935, showed 636 consecutive cases of cancer of the lip treated by irradiation. All of these cases were proved microscopically to be squamous-cell carcinoma. As a result of this study, the following pertinent facts were ascertained.

Lip cancer occurred about 38 times as frequently in men as in women, and about 29 times as frequently on the lower as on the upper lip. Of the total group of patients, 619 were men and 17 were women. The upper lip was involved 22 times, in 2 cases in females; the lower lip was involved 614 times, in 15 cases in females. Multiple lesions occurred in 12 cases. Six patients had two primary lesions involving the lower lip; 5 had primary lesions involving the upper and lower lip, and 1 had a primary lesion involving the upper and lower lip and also the tongue.

The youngest patient was 28 and the oldest 92 years of age. One hundred and ninety-eight cases occurred in the decade 60–70 years. The age in relation to clinical grouping is shown in Table I.

The extremes in climatic conditions to which farmers, postmen, painters, etc., are subjected are an etiological factor, 201 of our 636 cases falling into this category.

The use of tobacco was very common, 546 of the males and 7 of the females admitting its use in one form or another.

In 258 cases, the oral hygiene was considered to be bad. Trauma—razor cuts, burns, trauma from teeth—was a minor factor, being recorded in only 58 instances.

In 389 of the cases there was a history of cracked or chapped lips or chronic fissure; 197 cases had definite histories or signs of what were interpreted as keratoses. There were only 15 cases of leukoplakia. Duration of the symptoms was from a few months to several years.

TABLE I: CANCER OF THE LIP: AGE OF PATIENTS AND GROUPING

Age (years)	Total Number	Group I	Group II	Group III
20– 30	3	2	..	1
30– 40	28	15	10	3
40– 50	79	34	24	21
50– 60	148	76	53	19
60– 70	198	102	65	31
70– 80	134	78	28	28
80– 90	45	26	12	7
90–100	1	1	..	..

The incidence of syphilis in this group of cases, as determined solely by routine complement-fixation tests, was 3.6 per cent, or 23 cases. Only three of the patients with lip cancers associated with leukoplakia gave positive Wassermann reactions.

The material in this study was classified, according to the grouping made at the time of admission, as follows:

Group I	334 cases
Group II	192 cases
Group III	110 cases

Group I includes all primary cancers of the lip, and a few recurring cancers of the lip treated elsewhere, in which there were no demonstrable metastases or enlarged lymph nodes at time of admission, regardless of the size of the lesion.

Group II includes all primary cancers of the lip, or recurring cancers treated elsewhere, associated with palpable, movable lymph nodes, some of which were suspected of being metastatic.

Group III includes primary lip cancer with fixed metastases in the node-bearing

[1] From the State Institute for the Study of Malignant Diseases Buffalo, N. Y., B. T. Simpson, M.D., Director. Accepted for publication in June 1942.

areas; recurrence on the lip with metastases; cases where the primary lesion was treated elsewhere and was non-recurrent locally, but with fixed metastases in the neck regarded as inoperable.

Table II gives the number of cases in each of the three groups in relation to size of the primary lesion.

TABLE II: CANCER OF THE LIP: SIZE OF PRIMARY LESION AND GROUPING

Size (cm.)	Group I	Group II	Group III
Less than 0.5	6	0	1
0.5–1.0	42	19	4
1.0–2.0	144	74	14
2.0–3.0	40	48	18
3.0–4.0	13	10	15
4.0–5.0	9	5	7
5.0 and over	4	5	9

The measurements quoted above are based on 487 cases of which we had accurate record.

TREATMENT

The treatment of lip cancer must be considered under two heads: treatment of the primary lesion and treatment of metastases to the regional lymph nodes. It is well known that in the treatment of the primary lesion surgery and irradiation with radium or x-ray in general give comparable results. The cosmetic results following irradiation, however, are superior to those with surgery. The chief difficulty lies in the eradication of the metastatic lesion in the neck and occasionally in the ablation of the primary tumor where it is resistant to irradiation.

The treatment given in this series was primarily by means of x-ray and radium. We are quite satisfied with the results of irradiation of the primary lesion. The results obtained in the treatment of the metastases are still in the majority of cases unsatisfactory. It is not our intention, however, to enter into a discussion of the comparative merits of surgery and irradiation, but rather to urge that both methods be employed where indicated, in an attempt to improve the end-results in cases with metastases.

Primary Lesion

Group I: Out of 334 Group I cases, 300 primary lesions were treated with unfiltered x-rays; 28 by implantation of radon seeds; 5 by implantation of radium needles; 1 case with the radium bulb. The implantation of radon seeds or radium needles was used only in infiltrating tumors.

Group II: Out of 192 cases, 164 primary lesions were treated with unfiltered x-rays; 16 by implantation of radon seeds; 5 by implantation of radium needles; 6 by large radium pack applied directly to the tumor; 1 case by unfiltered x-ray to the primary growth later supplemented by radium pack treatment.

Group III: Out of 110 cases, 100 primary lesions were treated with unfiltered x-ray; 5 by implantation of radon seeds; 1 by implantation of radium needles; 4 by large radium pack applied to the lip.

Factors of Treatment: The factors of unfiltered x-ray treatment were as follows: 140 kv., 5 ma., H.V.L. 1.9 mm. aluminum, 20 cm. distance, 265 r per minute, dosage 1,600 r to 2,400 r in one treatment.

For radium implantation gold seeds were used, 3 by 1 mm. in diameter, with 0.3 mm. gold filter, the dosage being 1 mc. per sq. cm., or radium needles with 0.6 mm. platinum filter, 1 or 2 mg. per cm. length, left in the lesion from four to seven days, depending on their strength and number.

The radium bulb, used for superficial lesions, had 0.1 mm. copper filter; the distance was 1 to 2 mm. and the dosage 12 to 16 mc. hours.

The four-gram radium pack had 1 mm. platinum and 1.5 mm. steel primary filter, 0.5 mm. copper and 1 mm. aluminum secondary filter. The field size was 10 by 10 cm., the dose 50 r per gram hour, distance 10 cm., dosage 3,200 to 4,800 r.

Treatment of Metastases

Group I: Prophylactic treatment was given in the absence of palpably demonstrable cervical metastases in only 59 of Group I cases, in 7 of which metastases later developed. Eight other cases in which metastases eventually appeared had

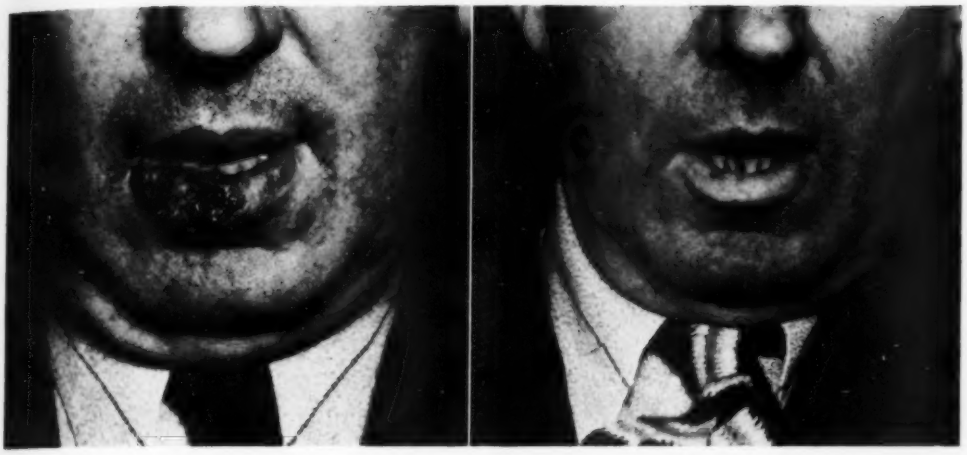

Fig. 1. Group I epithelioma of the lip before and after treatment. This patient (Case 20,521) was treated in 1934 with two doses of unfiltered x-rays, 1,175 r each. He is alive and well in 1942.

had no prophylactic treatment to lymph node-bearing areas.

Group II: The suspicious or definitely metastatic nodes which subsequently developed were treated with high-voltage x-ray or radium pack over the involved skin areas of the neck in 192 cases. In addition, 14 of these cases were treated with radium needles or radon seed implantation.

Group III: The metastatic nodes in the neck were treated by high-voltage x-rays in 73 cases, by large radium pack in 6 cases, by a combination of high-voltage x-ray and radium pack in 9 cases, and by implantation of radon seeds or radium needles with supplemental high-voltage x-ray in 22 cases.

The treatment of metastases was primarily by external irradiation.

Factors of Treatment: X-ray therapy factors were 200 kv., 25 ma., 0.9 mm. copper filter, 50 cm. distance, 59.6 r per minute; average dose 2,500 to 3,800 r over a period of two to three weeks.

With the four-gram radium pack the primary filtration was 1 mm. platinum and 1.5 mm. steel; secondary filtration, 0.5 mm. copper and 1 mm. aluminum; 10 by 10 cm. field; 50 r per gram hour; 10 cm. distance; average dose 3,200 to 4,800 r.

Gold seeds were 3 by 1 mm. in diameter, with 0.3 mm. gold filter; dosage 1 mc. per sq. cm.

Radium needles had 0.6 mm. platinum filter, 1 or 2 mg. per cm. length. They were left in the lesion from four to seven days depending on strength and number of applicators.

RESULTS

Group I: Of 334 patients treated, 232 remained well five years or longer (see Fig. 1); 69 died from intercurrent disease with the local lesion healed; 18 were lost from observation with the local lesion healed; 15 died of uncontrollable metastases which developed some time after admission (11 died from metastases with primary lesion healed; 1 from metastases with primary lesion healed after recurrence, and 2 from metastases with primary lesion not healed after recurrence).

The absolute cure rate for the group is 69.5 per cent. If those who died from intercurrent disease or were lost to observation with the local lesion healed from two to five years are eliminated, the cure rate is 93.9 per cent.

Group II: Of 192 patients treated, 131 remained well five years or longer (see Fig. 2); 19 died of intercurrent disease with the local lesion healed; 19 were lost from ob-

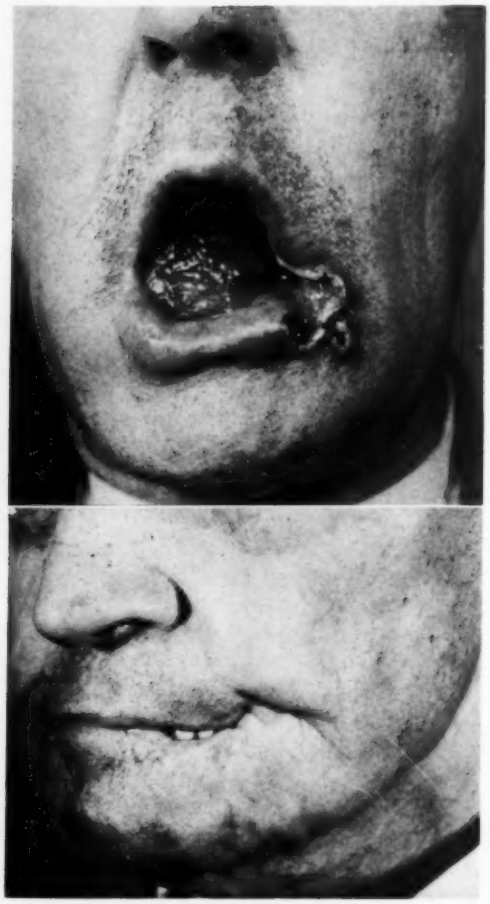

Fig. 2. Group II epithelioma of the lip with palpable submaxillary nodes, before treatment and after treatment of recurrence. This patient (Case 1,734) was treated by implantation of radium seeds in the primary lesion and metastatic nodes in 1929. A recurrence in the lip in 1933 was successfully treated by implantation of radium needles. The patient was alive and well seven years later, when last heard from.

servation with the local lesion healed; 23 died from the disease (19 died from metastases with primary lesion healed; 4 died from metastases with primary lesion healed after recurrence).

The absolute cure rate for Group II is 68.2 per cent. If those who died from intercurrent disease or were lost from observation with the local lesion healed from one to four years are eliminated, the cure rate is 85.0 per cent.

Group III: Of 110 patients, 12 remained well five years or longer; 6 were lost from observation with results not ascertained; 1 died from intercurrent disease with the primary lesion healed but metastatic nodes sclerosed; 91 died from metastases.

The absolute cure rate for this group is 10.9 per cent.

Cancer of the Upper Lip: In our series of 636 cases, 22, or 3.4 per cent, involved the upper lip; 20 of these were in males and 2 were in females. They are grouped as follows:

Group I	14 cases
Group II	5 cases
Group III	3 cases

Of the 14 patients in Group I, 9 remained alive and well five years or over; 4 died from intercurrent disease with the primary lesion healed; 1 died from the disease. Of the 4 patients who died from intercurrent disease, 2 were females.

In Group II there were 5 cases. Two patients were lost from observation with the primary lesion healed, but with metastases still present; 2 died from metastases with the primary lesion healed; and 1 was lost from observation with metastases in the neck and with the primary lesion not healed.

Of the 3 patients in Group III, all died of metastases with the primary lesion healed, and all 3 had positive section of the metastatic nodes.

The absolute cure rate for the upper lip cases is 40.9 per cent.

SUMMARY

The absolute cure rate for the total series of 636 cases is 58.9 per cent. If we eliminate the patients who died of intercurrent disease with the lesion healed at the time and those that were lost from observation with the lesion healed less than five years, the cure rate is 74.4 per cent.

Of 27 patients with positively proved metastatic lesions treated with radon seed and radium needle implantation and with high-voltage x-rays, only 2, or 7.4 per cent, remained well five years or longer. Of 11 patients with proved metastatic lesions

treated with high-voltage x-rays or radium pack alone, none survived.

Of 10 patients with metastatic lesions diagnosed clinically but not proved histologically, treated with radon seed and radium needle implantation and external irradiation, 9 were in Group II and 5 of these died from the disease, while 4 are alive and well; 1 was in Group III and is alive and well.

Nine patients in Group III with metastatic lesions diagnosed clinically but not proved histologically, treated with high-voltage x-ray or radium pack alone, are alive and well.

113 High St., Buffalo, N. Y.

Panel Discussion on the Leukemias and Lymphoblastomas[1]

R. R. NEWELL, M.D., Chairman
ERNEST H. FALCONER, M.D. JOHN H. LAWRENCE, M.D.
H. P. HILL, M.D. DAVID A. WOOD, M.D.
HARRY WYCKOFF, M.D.

Dr. Newell: We are proposing to discuss leukemias and lymphoblastomas, a group of diseases which affect the blood-forming organs and the lymphatic system. They are of unknown etiology. We could make a tabular classification, considering four cellular elements, namely leukocytes, granulocytes, erythrocytes, and reticulum cells, and observing that for each of these elements one may have benign plethora, a malignant plethora in the circulating blood, or a local proliferation to form a tumor.

Dr. Wood: In general, the most satisfactory classifications are those based on etiology, but in this group of diseases we do not know the etiology. Gordon's test for Hodgkin's disease by intracranial injection of rabbits proves now not to indicate necessarily a virus infection, but probably a reaction to eosinophils. Multiple enlarged lymph nodes in low-grade Brucella infection may add to the difficulty of differential diagnosis, but are probably actually not Hodgkin's disease.

At present we are classifying these diseases on a histologic basis and we can get an idea of the pitfalls to be expected if we look back a few years at our attempts to classify the various infectious granulomata on the basis of tissue reactions alone, before we knew their specific etiology. We could build up a very complex classification on the extreme variations in tissue reaction in tuberculosis, yet now that we know the etiology we see that these are all one disease. None of the pathological classifications is especially useful to the clinician. He might well prefer a simple classification into Hodgkin's disease, lymphosarcoma, leukemia, and even mycosis fungoides for good measure.

The pathologist has to deal with secondary response of the various types of cells. Here is the classification of Callender of the American Registry of Lymphatic Tumors. In the column under reticulum cell he has included Gaucher's disease, and I think in the same category we should mention various infectious granulomata which elicit a monocytic response.

Hodgkin's disease is so ill understood at the present time that it is set off separately. The common denominator in this disease is the reticulum cell, yet the reticulum cell is not always the predominating type. The reticulum cells may be rather unstable, so that sometimes in Hodgkin's disease they are seen undergoing a neoplastic proliferation, transforming the condition into reticulum-cell sarcoma. At other times they form giant cells.

Dr. Newell: Dr. Wyckoff, I suppose in your clinical experience you have found the ordinary run of cases falling into a simpler classification than this? Don't you think that a classification into lymphatic leukemia, acute and chronic, and myelogenous leukemia, acute and chronic, would cover 80 or 90 per cent of what the hematologist is going to see, leaving out Hodgkin's disease because its blood picture is not characteristic?

Dr. Wyckoff: It might be made as simple as that, but you have to keep in mind the other things which occur infrequently; otherwise you will miss certain important cases, very much to your discomfort. We certainly cannot ignore the cases with proliferation of the monocytes or the plasma cells.

Dr. Hill: As a matter of fact the clinical classification into leukemias, lymphosar-

[1] This is a condensation of a Panel Discussion presented before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, in San Francisco, Calif., Dec. 1–5, 1941.

CLASSIFICATION OF TUMORS AND TUMOR-LIKE CONDITIONS OF THE LYMPHATIC, HEMOPOIETIC, AND RETICULAR TISSUES

(Copied from Callender, G. R.: Am. J. Path. 10: 445, July 1934.)

Adult Cell Type	Lymphocyte	Myelogenous		Reticulum Cell	
		Granular Leukocytes	Red Blood Corpuscles	Reticulocyte Monocyte	Hodgkin's Disease
Reactions	"Lymphoma" Lymphocytosis	Leukocytosis	Symptomatic polycythemia	Gaucher's disease Niemann-Pick disease	Localized (sclerosing)
Proliferations of neoplastic type	Leukemic lymphocytoma 1. Chronic 2. Acute	Leukemic myelocytoma 1. Chronic 2. Acute	1. Polycythemia vera (Syn. Erythremia) 2. Leukemic erythrocytoma	Leukemic reticulocytoma (Syn. Monocytic leukemia)	←
	Aleukemic lymphocytoma 1. Diffuse 2. Nodular	Aleukemic myelocytoma 1. Single 2. Multiple (Syn. Multiple myeloma)	Aleukemic erythrocytoma	Aleukemic reticulocytoma	Generalized (cellular)
Malignant tumors	Lymphosarcoma 1. Aleukemic 2. Leukemic (Syn. Lymphatic leukosarcoma)	Myelosarcoma 1. Aleukemic 2. Leukemic (Syn. Myelocytic leukosarcoma) Chloroma	Erythrosarcoma 1. Aleukemic 2. Leukemic	Reticulum cell sarcoma	Sarcomatous

comas, and Hodgkin's disease will cover 80 or 90 per cent of the cases that we see.

Dr. Newell: Then we all agree that there are many cases of leukemia which we classify as outright myeloid or outright lymphatic. An experienced hematologist will detect some such cases before there is quantitative increase in the white cell count. Don't you want to talk about your ability to discover some of these cases before they become florid?

Dr. Wyckoff: In those cases which we have had an opportunity to watch and that eventually turned into frank leukemia, I think I have never found one where intensive search of the slides made in the aleukemic stage did not give information, or at least a strong presumption, of the ultimate development.

Dr. Newell: If you are contented with this clinical classification, Dr. Falconer, will you speak further about the separation of leukemias into acute and chronic?

Dr. Falconer: I think we make the distinction for the purpose of treatment and for prognosis, for of course the patient's family is insistent on knowing what you think is going to happen and how soon it will happen.

Dr. Newell: Don't you think that in acute myelogenous leukemia and chronic myelogenous leukemia the expected course and outlook are so utterly different that they almost look like two different diseases even though they are both characterized by a high white count; and the same with lymphatic leukemia? Isn't it almost as if we had four diseases instead of two?

Dr. Falconer: Well, yes and no. There are resemblances between them which are very striking but, on the other hand, they behave as if they might be separate diseases.

Dr. Newell: What I am trying to find out is how you tell the acute from the chronic with such certainty? What is it that makes you sure that a certain case is going to run a very rapid course without remission?

Dr. Wyckoff: Our chief concern in differentiating between acute and chronic leukemias is the cells themselves, although there are certain clinical features that are very important, such as fever, mouth infections, and particularly rapid loss of strength and prostration, often very marked. But it is the cells that give us the clue as to whether we are dealing with acute

or chronic leukemia. If you have an arrest at a very early stage in the development of the cell, you may assume that the process is probably acute; then if the clinical features mentioned—or some of them—are present or there is a severe anemia, you can be pretty sure of it.

Dr. Newell: Just how dependably could you differentiate between an acute leukemia and a chronic leukemia from the blood picture alone, before seeing the patient?

Dr. Wyckoff: That's not a proper question. This isn't a stunt we are putting on. What we are trying to do is to determine the diagnosis and treat the patient. There is always somebody standing at your elbow, or there ought to be, telling you all the things that he knows about the patient from history and physical examination.

Dr. Hill: It is a very difficult thing at certain times to distinguish between an acute exacerbation of a chronic leukemia and an acute leukemia. A history of illness over a period of time and the presence of a quite large, often hard spleen suggest the chronic form. In the acute leukemias the spleen is only moderately enlarged, sometimes not palpable, and the lymph nodes are rarely large. In the acute form x-ray therapy has proved of no benefit.

Dr. Newell: Are you all willing to accept this proposition, that it is not going to do any good to give x-ray treatment in an acute leukemia?

Dr. Lawrence: No, I would not accept that. If there is nothing else you can do you might as well give some x-ray or other form of radiation. Once in a while you see an acute case of leukemia turn into a chronic one. I have seen that happen twice.

Dr. Newell: Have you actually seen some acute leukemias show a remission?

Dr. Lawrence: I have seen several during the last five years.

Dr. Wyckoff: How long did those remissions hold?

Dr. Lawrence: I can think of one patient with acute myelogenous leukemia, a man about 41, who had 90 per cent 'blasts in the blood and the picture turned into one in which all of the cells were either polymorphonuclears, lymphocytes, or monocytes, the remission lasting for about four months. I also saw a child in whom the cells switched from very young 'blast forms to much more mature forms.

Dr. Wyckoff: Did the spleen get big at the same time?

Dr. Lawrence: Eventually, yes. But what harm can you do if the patient is going to die in a month or six weeks anyway? You have a 1 per cent chance of turning the condition into a chronic leukemia.

Dr. Hill: That 1 per cent chance is very likely the one I mentioned—a chronic leukemia with an acute exacerbation. (Laughter.)

You must admit to the family that in all probability x-ray is not going to do the patient any good; it seems wrong to me to hold out a vain hope to the family.

It is of no practical importance whether it is a case of an acute leukemia showing a remission, or of an error in classification. It is also unimportant whether the unexplained remission arose spontaneously or was really dependent upon the irradiation. The important thing is that 1 or 2 per cent of patients with leukemia will have a remission when one would have prophesied that such was impossible.

Dr. Newell: I for one would like a chance to treat them all, however hopeless the proposition looks in a given case, promising not to use big enough doses to make the patient more uncomfortable than he already is.

Being myself convinced that irradiation is the treatment for leukemias, I was interested recently to hear Dr. Falconer quoted as advocating medicinal treatment.

Dr. Falconer: That means arsenic, of course. I would say that those cases which will be benefited by arsenic will be benefited by x-ray. But sometimes cases which have become refractory to x-ray may still be influenced by arsenic. I do not think arsenic is used enough and I do not think that it is properly used in all cases. Dr. Claude Forkner, of New York, has had a very successful experience in the use

of arsenic both in myelogenous and lymphatic leukemia, but by far the better in myelogenous. He begins with 5 minims of Fowler's solution three times a day for three days and then increases it to 6 minims three times a day for two days, increasing 1 minim three times a day until the patient is getting 10 minims three times a day, that is 30 minims a day. That is a good dose, but Doctor Forkner increases it about a minim a day until he gets a toxic reaction, with diarrhea, vomiting, ecchymosis of the eyelids or conjunctivitis or a skin eruption. After this he stops three days and then goes back to about 30 minims a day. He feels that the secret of success is relentless dosage and that the dose should not be diminished until the leukocyte count is near normal, when the amount can be gradually reduced to 8 or 9 drops a day. He disregards mild toxic symptoms, and will not omit the medicine for longer than a week. If a patient cannot bear arsenic by mouth and it must be given by rectum, about twice the dosage will be needed. If it has to be given by vein, then the 1 per cent solution of arsenic trioxide must be made up without the tincture of lavender which is in Fowler's solution. The day's dose is diluted to 20 c.c. with normal saline solution.

I recently saw in consultation a young girl about twelve years of age who for some time had had a white cell count between 100,000 and 300,000, mostly lymphocytes and fairly mature but with some lymphoblasts. She was getting weaker and more anemic and when I saw her was confined to bed, with fever and some bleeding from the gums. She was to have a transfusion, but in the four days that it took to arrange this the white cells rapidly rose to a million per cu. mm. The doctor in charge gave her the transfusion and then put her on Fowler's solution and in three weeks her blood count was 7,000, still with a rather high percentage of lymphocytes. In two more weeks she was playing outdoors and she lived for seven months more. It might well be that x-ray would have produced the same remission.

Dr. Newell: I think we all agree as to the usefulness of transfusion in such a patient as Dr. Falconer has described. But here is a case to show what arsenic can accomplish. Dr. Hill, would there be cases in which you would choose arsenic first as your therapeutic agent?

Dr. Hill: No. Anyway, how do we know that there was not a spontaneous remission in this case?

Dr. Newell: I really was not asking you to argue Dr. Falconer's case. Anything can be proved by anecdote—or nothing. (Laughter.) I was asking for your clinical judgment.

Dr. Hill: Years ago I used arsenic, in gradually increasing dosage as Dr. Falconer has described. In my experience it had some result, but it does not compare with the use of x-ray.

Dr. Newell (turning to Dr. Lawrence): I suppose you are completely addicted to radiation, aren't you? Or are there any leukemia cases for which you, too, would first use arsenic treatment?

Dr. Lawrence: I am not prepared to enter the argument at the moment. I think there is actually not any clean-cut evidence that arsenic is better than x-ray.

Dr. Wood: What is it that x-ray and arsenic do anyway? Do they kill the white blood cells or do they stimulate them? Are the leukemias really a neoplastic disease at all? One wonders if it isn't some type of inhibition that stops the cells from maturing beyond the 'blast stage?

Dr. Newell: Does someone want to answer that? I wish we knew.

Is there anyone here at the table who wants to make a complaint because I have spoken just of leukemias and their treatment and have not differentiated between myelogenous leukemia and lymphatic leukemia?

Then I would like to go on to a consideration of the management of radiation treatment of leukemia. Some believe that the dosage should be kept at a minimum. Some would stop after a reduction of the white count to 40,000. Some fear to give radiation in the presence of anemia. Some,

on the contrary, see no cause for alarm in reduction of the white count even down to 5,000 or less, and some expect recovery from the anemia as the plethora of white cells is sloughed away. How do you feel about keeping the doses small, Dr. Lawrence?

Dr. Lawrence: We have tried large doses, medium doses, and small doses, and it is our feeling at the present time that we get just as good results giving the least amount of radiation that will bring about an improvement in the condition and improvement in the blood picture. Our small dose (radiophosphorus) is equivalent to 4 to 8 roentgens whole body irradiation per day over a period of four to eight weeks.

Dr. Newell: Don't you use local irradiation?

Dr. Lawrence: No, not at all; we are treating all our patients with radioactive phosphorus, giving very small doses over a period of four to six weeks.

Dr. Newell: If the patient has localized disease my inclination would be to start with local treatment in quite small doses, 25 roentgens to the spleen or 25 or 50 roentgens to the lymph nodes, and if that is not effective increase the daily dosage. Do you think I am going too slowly, Dr. Hill?

Dr. Hill: If you have a high count and a large number of immature cells it is better to begin with a small dose.

Dr. Newell: How impatient are you in getting the white count to come down, Dr. Lawrence?

Dr. Lawrence: As I said, we would work over a period of four to six weeks; if the count started at 300,000, it might have gone down to 150,000 at the end of three or four weeks.

Dr. Newell: Haven't both of you often seen the white count go down quite spectacularly from 100,000 or more to 5,000 or 10,000 in the course of a couple of weeks, after a small quantity of radiation?

Dr. Hill: Yes, but the general condition of the patient is the important thing. The white count is secondary.

Dr. Newell: Dr. Wyckoff, if a patient has had some radiation and you find that the white cells are running down very fast from a high level, and they get as low as 2,000 or 3,000, are you pretty much frightened about the patient?

Dr. Wyckoff: I think, if you go about the treatment slowly enough at first, this ought not to happen. I think the kind of immature cells seen in the circulation should be the guide to start with a very small dose. But if we have not been using large doses, I think we ought not to pay too much attention to the white count. Most important is the clinical condition of the patient. Later in the treatment the behavior of the red count is a good guide.

Dr. Newell: I give a patient a few 50-roentgen doses to his spleen and see his white count go down to 4,000 or 5,000. I maintain stoutly that, since this effect has been attained with such small quantity of x-ray, I have not by any means done the patient harm, but only good. Am I deluding myself?

Dr. Hill: No, I think not, since the reduction in the white count is not the main objective. The improvement of the patient's condition is the main objective.

Dr. Falconer: I would not be particularly alarmed about driving the white count down. But we ought to keep clearly before us the fact that we cannot cure the patient; that obviously we are using x-rays to control symptoms. I would also pay attention to the basal metabolic rate. It is not the number of cells that we are treating. When the patient's symptoms are relieved, it is time to stop treating him. I have had patients whose white count went down to 1,500 and as far as I can see it did not do them any particular harm. I have had other patients with a count of 60,000 or 70,000 with good maturation of the cells, whom we stopped treating when they were symptomatically comfortable.

Dr. Newell: The next proposition concerns anemia. Some fear to continue the roentgen treatment of leukemia when the patient develops an anemia lest harm be done the red cells. I would make the contrary proposition, namely, that the

anemia may be due to the leukemic process, and persistent use of small doses of x-ray may actually bring the red cells up while the white cells are coming down.

Dr. Hill: An improvement in the anemia frequently occurs during and after x-ray treatment. A marked anemia before or during treatment is best treated by transfusion.

Dr. Lawrence: These patients have their anemia, it seems to me, in most instances, because of invasion of the marrow. We are inclined always to try radiophosphorus in these cases even though anemia is present, but we give smaller doses.

Dr. Newell: I wonder if you feel that the general irradiation with radiophosphorus is a little more dangerous than local x-ray treatment to the spleen or lymph nodes?

Dr. Lawrence: Yes, I think radiophosphorus is a very dangerous thing to use unless carefully controlled. Experience is not yet very great. There are only five centers that are using it in this country and one in South America. As time goes on we may be able to say more definitely what its advantages are. At present I would note particularly that this material apparently gives no radiation reactions or radiation sickness.

Dr. Newell: Do you sometimes feel that biopsy of the bone marrow helps you decide whether or not radiophosphorus ought to be given?

Dr. Falconer: It gives very valuable information. By and large, if one found the marrow packed with immature cells and there were no considerable deposits outside the marrow, then one would hope to reach the disease with radiophosphorus. But if there were large deposits outside of the marrow in addition, I would be less inclined to use radiophosphorus. I would choose to treat the large spleen or large groups of lymph nodes with x-ray. Sometimes in these acute cases one knows that the chances are much against success; nevertheless, x-ray treatment is about the only thing that one can use, with the possible exception of arsenic.

Dr. Newell: What I am trying to find out is whether bone marrow biopsy is just a way of studying the disease or does the patient need the biopsy to decide his treatment?

Dr. Wyckoff: I think usually it is possible to tell from the condition of the other tissues. If there are infiltrations other than in the bone marrow, you know that you are going to attack these and you do not need a bone marrow biopsy to tell it.

Dr. Newell: Shall we go on, then, to the consideration of Hodgkin's disease? This is probably a generalized disease like leukemia, generalized from the moment that you first see it, and incurable by the extirpation of the group of enlarged lymph nodes. And we all agree that the size of the tumor is no measure of the severity of the disease. Sometimes the largest tumor is found in the patient least disabled by the disease. Many cases can be expected to do well for some or many years. But we all have seen Hodgkin's cases which go into a hopeless, resistant stage in a few years or months.

Let us discuss the dosage. In this disease, which I know to be incurable and generalized, my inclination is to get relief of the patient's symptoms with the least irradiation possible. I hope for a remission, but I am inclined to be very patient with the rate of regression of the enlarged nodes. I would be inclined to start out with doses of 50 roentgens rather than 250.

Dr. Falconer: I am not an expert in dosage, but my feeling in the matter is that the smaller the dosage we can use to relieve the patient's symptoms, the better. There are times, however, when we can expect to need pretty heavy doses, especially when there is involvement of the mediastinum with fluid in the pleural sac or when we have masses of enlarged nodes in the retroperitoneal spaces. I have no feeling against using large doses if they are needed.

Dr. Newell: How about the correlation of size of lymph nodes with the state of the disease. Dr. Wood, have you had some patients come to autopsy in the toxic stage of Hodgkin's in whom there was really

very little enlargement of the lymph nodes to be discovered?

Dr. Wood: Yes. Some of the more acute cases of Hodgkin's disease may show remarkably little lymphadenopathy and very little enlargement of the spleen. Does the state of the disease determine the dosage that you would advise?

Dr. Newell: I have seen patients with a large Hodgkin's tumor, not ill at all, in whom it took very large amounts of radiation to shrink the tumor. I have seen other patients in whom the tumor subsided after just a few small doses. In some cases where the disease is very widespread I have irradiated the whole body, using 10 or 20 roentgens, repeated every day or every few days. I would like to ask Dr. Lawrence if he feels that total body irradiation done with radioactive phosphorus possibly has a place in the treatment of Hodgkin's disease?

Dr. Lawrence: Probably not.

Dr. Newell: I think we are all aware that infiltration of Hodgkin's tissue in other parts of the body than the lymph nodes can be expected to be resistant to radiation. In my experience the easy and enduring remissions have come when the disease was apparently limited to the lymph nodes. Is there any tissue in the body, Dr. Wood, that you have not seen infiltrated with Hodgkin's?

Dr. Wood: None that we have found.

Dr. Newell: Let us now leave Hodgkin's disease and go on to lymphosarcoma. Lymphosarcoma probably does often start as a truly localized disease curable by surgical removal or radiation destruction. There are undoubtedly cases of lymphosarcoma which are generalized when first seen, but there are other cases in which the disease really is localized at first. Dr. Wood, can you tell these two types apart, the localized and the generalized, just from their microscopic appearance?

Dr. Wood: I fear that I am unable to do so.

Dr. Newell: How does Dr. Hill feel about the clinical differentiation of the two types?

Dr. Hill: The generalized type starts in the lymph nodes, often in the neck, and is very much like Hodgkin's disease. Small doses of x-ray will make the nodes disappear, but the disease will very likely reappear, not at the site of irradiation, but elsewhere, frequently at a distance.

Dr. Newell: Then there would be cases in which, without the microscopic appearance, you would not know whether you were making a correct diagnosis between Hodgkin's disease and lymphosarcoma?

Dr. Hill: That's correct, and the distinction would be of no value.

Dr. Newell: But I take it that there is value in making a distinction between the localized type of lymphosarcoma and the generalized type of lymphosarcoma? In the localized type I would irradiate very heavily, just as if it were a case of known neoplasm like carcinoma. In the generalized type I try to get along with the smallest possible dose of x-ray that will give the patient relief from the symptoms.

I would like to have more time to discuss the question of Hodgkin's infiltration of the skin. But leukemia and lymphosarcoma may also infiltrate the skin. In appearance and in response to irradiation these skin infiltrations by the different lymphoblastomas are very similar. How different do they look through the microscope?

Dr. Wood: In the early stages the three diseases may be indistinguishable. The follicular type of lymphoblastoma (infiltrating the skin) ought usually to be recognized.

Dr. Newell: I would like now to consider the blood picture in Hodgkin's disease.

Dr. Wyckoff: Sometimes there is an increase in the number of white cells in Hodgkin's, but it is not the kind of an increase that would cause a difficulty in differentiating from leukemia. There is no blood picture that I know of that is characteristic of Hodgkin's disease. It does sometimes happen in advanced cases that one sees a blood picture which could be described as leukemoid, but I think one

would seldom have difficulty in differentiating this from real leukemia.

Dr. Newell: Does Dr. Hill feel that there are cases in which he would have to have a biopsy of a lymph node or a biopsy of bone marrow before he knows where he stands?

Dr. Hill: Certainly.

Dr. Newell: There isn't much time left, and I think we had better submit to questions from the floor.

Question: What about the use of Fowler's solution along with x-ray?

Dr. Falconer: Our statistics on 39 cases of myelogenous leukemia and 26 of lymphatic treated with arsenic and x-ray combined gave an average duration of life of over four years, indicating that there is an advantage in this combined treatment. Forkner himself (an enthusiast for arsenic) feels that there might be advantage in combining the two methods of treatment.

Question: Is there danger of splenitis from too much treatment to the spleen?

[No one at the table thought there was danger of splenitis.]

Question: What about the sputum count and the explanation of roentgen effect?

Dr. Falconer: What you mean is the counting of white cells in the saliva. In my experience there may be a rough ratio between the number of cells being destroyed by irradiation in the body and the number that appear in the saliva, but it does not seem to have any practical value as far as I have been able to observe.

Question: Is there any damage to the function of the spleen other than the destruction of the white cells when radiation is directed to the spleen?

Dr. Newell: The answer is no.

Question: What is your basis for believing that Hodgkin's disease is never local?

Dr. Newell: Because I have never succeeded in curing a case of Hodgkin's disease, however early treatment was begun, and I have never seen a case cured by surgical extirpation of the group of enlarged nodes. Has anyone at this table had a contrary experience? [None cited.]

Question: Aleukemic leukemia?

Dr. Newell: Dr. Wyckoff thinks he can often detect a case of leukemia before it shows a high white count, and what are your views about therapy, Dr. Wyckoff?

Dr. Wyckoff: Well, any time that the patient shows symptoms. . . .

Dr. Newell: If he had an anemia, you would give him some treatment? And if he seemed well when you discovered the condition in his blood, you would just watch him? Is that it?

Dr. Wyckoff: That is all you would do.

Dr. Newell: Do you feel, Dr. Falconer, that the prognosis of an aleukemic leukemia is any different from that of the disease discovered in the obvious stage?

Dr. Falconer: I don't think I can answer that. I have a patient now who has only about 2,000 white cells and a differential count that indicates something abnormal is going on. His spleen is large and his bone marrow is packed full of lymphocytic and lymphoblastic cells. He is not doing very well and has had to stop work. I would like to try small doses of radiophosphorus on him. What does Dr. Lawrence think?

Dr. Lawrence: My experience has been that cases with a low white count don't do as well as those that have a high white count, but I do agree that with the abnormal cells packing the marrow we ought to try radiophosphorus.

Question: Dr. Falconer, do you think in myelogenous leukemia treatment with arsenic is as efficient, for longevity, as active x-ray therapy?

Dr. Falconer: That's hard to answer. We have already mentioned that a combination of x-ray and arsenic prolonged life a little better than x-ray alone. For arsenic alone, one can say that the cases that respond to arsenic probably would have about the same response to x-ray. I have a feeling that x-ray may give a little longer remission than arsenic alone.

Dr. Newell: The time of adjournment has arrived. I thank you all.

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Technic for Chest X-ray Examinations of Large Groups[1]

Part I: The Use of Standard Size Films

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IT IS GENERALLY agreed that the most satisfactory method of examining the chest is by means of the x-ray. Roentgenographic surveys of large groups are growing in popularity and may be expected to become progressively more frequent. Although the film usually accounts for only about 20 per cent of the cost of the x-ray examination, this figure is not correct when large numbers of persons are examined at one time; the proportionate cost attributable to film then rises considerably. For this reason many compromises have recently been made by using films of substandard size and film substitutes.

The impression has sometimes been given that satisfactory results and rapid speed of examination cannot be attained with the standard 14 × 17-inch films (1). This is by no means the case. In our experience the largest part of the time required with any method is consumed in getting the patient into the proper position. Standard 14 × 17-inch roentgenograms can be produced, therefore, as rapidly as any of the substandard sizes, or even roentgenograms on photographic paper in rolls.

The mass survey problem is likely to arise many times during the present crisis and a description of a few of the technical procedures used in the examination of approximately 50,000 selectees at the Los Angeles Army Induction Station is, therefore, in order. Frequently as many as 300 men or more have been examined daily with the apparatus which is to be described, and its capacity is considerably greater.

It must be remembered, primarily, that greater degrees of speed and efficiency can be attained when the patients consist solely of co-operative young men, than could possibly be reached with any other group. The men are stripped to the waist and arranged in long lines in such a way that each one has the opportunity of watching the examination of five or six others before his turn comes (Fig. 1). White lines are painted on the floor to keep the men in file, and the man at the head of the line is stopped in such a place that he must necessarily observe the position assumed by his predecessor at the time the exposure is made. Under these circumstances the men close to the head of the line become familiar with what response should be made to the commands, "Stop breathing," "Don't move," etc., as well as the proper position to be assumed.

For registration purposes each man has a number marked on the back of his hand with gentian violet at the beginning of the day, which becomes his number for all the laboratory examinations in the Station. Mistakes in changing the identifying letters of lead placed against the films are very rare, since the numbers on the hands make identification so simple. Exposures are made by measuring the chest and using a range of kilovoltages proposed by Weyl and Warren (4). Exposure times of 1/20 to 1/30 seconds are used with milliamperages of 300 to 400. Although several types of tubes can be used if one is satisfied with compromises, the best results are produced by a rotating anode tube. The capacity of this tube, as well as its ability to store heat, is sufficient so that these factors need not be considered and do not cause any slowing of the procedure.

One cannot help but feel apologetic in describing such simple things as the number of technicians, cassettes, and film

[1] Accepted for publication in June 1942.

hangers necessary but, judging by the wide range of guesses which several of us made before the work was started, such data may be in order. Actually, three cassettes proved to be sufficient. They were passed through the usual type of cassette tunnel into the dark room to be immediately reloaded. There were two technicians in the radiographic room. One usually measured the patient and set the kilovoltage of the machine accordingly, while the other changed the film and placed the patient correctly before it.

Fig. 1. Men lined up for chest examination. All can see and later imitate the one being examined.

Two men worked in the dark room loading cassettes and hanging and developing film. Films were developed in racks which would hold eight hangers. Light-tight safety boxes of two types were provided for exposed films so that the lights could be turned on in event of emergency whether or not the exposed films were on their hangers. These safety boxes also enabled the exposures to be continued and the patients to be sent home regardless of whether immediate film processing was possible. As a matter of actual practice, the developing room, with its capacity of more than 120 films per hour, was seldom overloaded.

The films were developed in ten-gallon tanks on a time-temperature basis, with no attempt to control the temperature of the incoming tap water. The developing time varied, accordingly, from three to five minutes. The fixing time was five minutes, and the time in each of two "cascade" washes was five minutes. Developing replenisher was usually added at the rate of 5 gallons daily, while the fixing bath was replenished in a similar way with a lesser amount, to keep its clearing time at about three minutes. The inflowing water was arranged to spray diagonally in jets from the bottom of the final wash tank. The water in this tank approached in turbulence a mountain stream. Water flow into the first of the two wash tanks was also arranged to produce maximum turbulence, and all of the water was exhausted through the master tank which contained the developer and fixer inserts. A change of water through all the tanks,

therefore, occurred at the rate of 10 gallons a minute.

After the films had been processed they were transported, still on the same hangers in frames of eight, on small trucks through a light trap into the drying room. Here they were arranged in long rows, toward which two 1/4 h.p. fans were directed (Fig. 2). Drying time varied from twenty to thirty-five minutes depending upon the humidity. One hundred and twenty-five hangers were necessary, and stringers

Fig. 2. Simple wooden racks and fans for drying films. The lines and clothespins are for use with overloads.

across the ceiling with ordinary clothespins were provided in case of overflow. In emergencies, films can also be laid out to dry on muslin.

Interpretation and reporting of the films were simplified by reference to the recommendations of the Army Medical School on the size of calcifications and other minor lesions, which are acceptable. Further simplification was attained by the use of a number of standard descriptions couched in language sufficiently clear to be understood by any clerk and in terms found in the Army index. Frequently a change of a few words or the notation of a particular region was all that was necessary to make such a standard form adaptable as a satisfactory report. Such simplification has the further advantage that any stenographer is suitable, not necessarily one trained in medical terminology.

Since the work in a "production line" of this sort soon becomes routine, it is apparent that, with a few exceptions, skilled technicians or dark-room technicians are not necessary. It is a great mistake to assume, however, that too many inexperienced hands can be used, especially in the beginning.

Reports in the German literature (2) state that men are examined at the rate of 300 or more an hour with the microfilm method. It may be, however, that these figures emanate from the Propaganda Ministry. The most time-consuming procedure in any country, or with any method, must necessarily be the measuring and positioning of the men. Because the

human element is involved, this portion of the work cannot be made to proceed entirely with mechanical efficiency. In our experience a speed of 100 an hour was routine, although more than 125 an hour was attained when medical students were examined, because of the intelligent cooperation of such a group.

CONCLUSIONS

1. A description of equipment and methods for roentgenographic chest studies of large groups with standard 14 × 17-inch films is given.

2. Since most of the time consumed in any mass survey goes toward measuring and positioning the patients, this method can be made as rapid as any of the methods employing film of substandard sizes, paper rolls, etc., and has the advantage that the films are of much better diagnostic quality.

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Technic for Chest X-ray Examinations of Large Groups[1]

Part II: The Use of Miniature Films

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DETAILS FOR exposing and processing large numbers of 14 × 17-inch films are given in Part I of this discussion (p. 306). The technic with 4 × 5 and 4 × 10-inch films does not differ greatly. Target-film distance is decreased, a compromise necessitated by the immense x-ray output required with present photoroentgen equipment. For the same reason kilovoltages are increased so that the working range falls between 70 and 95, while the milliampere second output must rise to 40 or 60 milliampere seconds or even more.

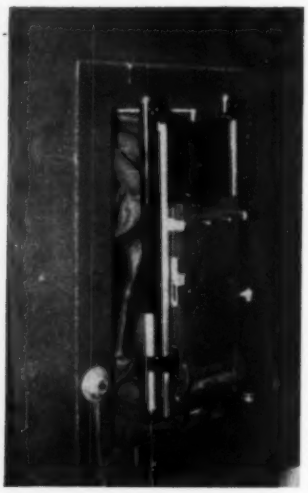

Fig. 1. The camera end of the photoroentgen unit protrudes through the dark room wall. Films need not, therefore, be placed in light-tight holders.

Since, with the stereoscopic technic such as is used with 4 × 10-inch films, two exposures are required in rapid sequence, some of the heavier exposures which may be necessary represent heavy loads on the tube. The stationary anode tubes developed for use for the Army have focal spots which are 5 mm. wide. Their capacity is theoretically sufficient. Experience, however, indicates that these tubes, even when equipped with air-cooling devices, show such rapid target wear that it is wise to have a spare tube always on hand as a stand-by.

Several modifications in processing technic can be used with the 4 × 10-inch films because of their small size. Two types of hangers are available for these small films. In one type, eight films are processed in horizontal position in a "double-deck" hanger. A simpler type of hanger allows three of these 4 × 10-inch films to be suspended side by side in a vertical direction. The latter hangers have the disadvantage that films occasionally fall out in the solutions.

A developing time of ten to twelve minutes is usually required in order to get maximum blackening effects with as low a load as possible on the tube.

Whatever type of hanger is used, it usually takes longer to dry the hanger than the film, even if compressed air is used to blow water out of the corners. When haste is imperative, the films can be placed in a clothes wringer after being folded in a towel, or water can be removed by sponges. The film thus devoid of droplets of water can be dropped easily into a dry hanger of the vertical type in which no fasteners are used. Rubber bands may be useful to prevent films from curling and dropping out of this type of hanger when partly dry, although curling does not occur if the films are not overheated.

A considerable amount of time and the services of at least one technician can be saved by having the film end of the photoroentgen unit actually protrude through the wall into the dark room (Fig. 1).

[1] Accepted for publication in June 1942.

This same plan can be used with film of any size. It has the great advantage that film can be placed ready for exposure in the unit without the use of cassettes. Likewise, no covers need be placed on film holders, etc.

For installations in which large numbers of men must be examined rapidly, two photoroentgen units (or film holders of any kind) and two x-ray tubes may be operated from one x-ray machine, as is indicated in Figure 2. The lead-covered wall separating the units protects the personnel who are positioning the patient on one side while exposures are being made on the opposite side. Since the greatest amount of time required in any method is consumed in getting the patient into the proper position, this plan enables two lines to pass through almost as rapidly as one line ordinarily moves. An additional registry clerk and technician are, of course, necessary. Two x-ray tubes are required because of the heavy loads involved. Were stereoscopic exposures not needed, or were the loads lighter, it would be possible to shift a single tube from side to side into an appropriate position in front of one photoroentgen unit or the other.

The compromises necessitated by the requirements of the present-day photoroentgen units might be expected to produce films of inferior contrast and detail, and, as a matter of fact, they do. High kilovoltages, target-screen distances of 40 inches, screen grain, and coarse focal spots all go to produce poorer detail and contrast in the image.

Whether this inferior quality affects the accuracy of diagnosis markedly can be determined by comparing large groups of single 14 × 17-inch chest films with 4 × 10-inch stereo chest films. Such a comparison is made below on patients of the same type; nearly all the interpretations were made by the same radiologist.

With single 14 × 17-inch films 13,494 cases were examined. The findings were as follows:

	Number	Percentage
Group 1: Small calcifications (juvenile type)	882	6.5
Group 2: Excessive calcifications (juvenile)[2]	216	1.6
Group 3: Active pulmonary tuberculosis	144	1.1

In contrast is a group of 36,194 cases with stereoscopic examinations on 4 × 10-inch films:

	Number	Percentage
Group 1: Small calcifications (juvenile type)	1166	4.7
Group 2: Excessive calcifications (juvenile)[2]	198	0.55
Group 3: Active pulmonary tuberculosis	411	1.17

A considerable decrease in the number of cases with calcifications appears in the studies made with 4 × 10-inch films. This is partly to be explained by the fact that the contrast is so marked in the photoroentgen films that soft-tissue shadows—especially in the hilar regions—have almost the same density as calcifications. The latter are, therefore, not identifiable.

It was surprising to me that rejections for active tuberculosis of the type in which actual parenchymal infiltration was present (Group 3) were as high (or even higher) with the small films as with the large ones. This can perhaps be explained in part by the magnification of small lesions which is apt to occur because of the short target-film distance. It must be admitted, therefore, that even though these small films are lacking in many desirable diagnostic qualities, they do, nevertheless, serve as a relatively satisfactory screening method for mass examinations of the chest.

A further disadvantage of the use of small films is to be found in the relatively long exposures which are now necessary. As a result, motion of the basal trunks

[2] Calcifications of the juvenile type, Group 2, were a basis for rejection according to the standards proposed by the Army Medical School, *i.e.*, (1) parenchymal nodulations—multiple—more than 10 in number or if the diameter of any one be greater than 1.0 cm. or if more than one be larger than 0.5 cm.; (2) lymph node densities—multiple—more than 5 in number or if the diameter of any one be greater than 1.5 cm.

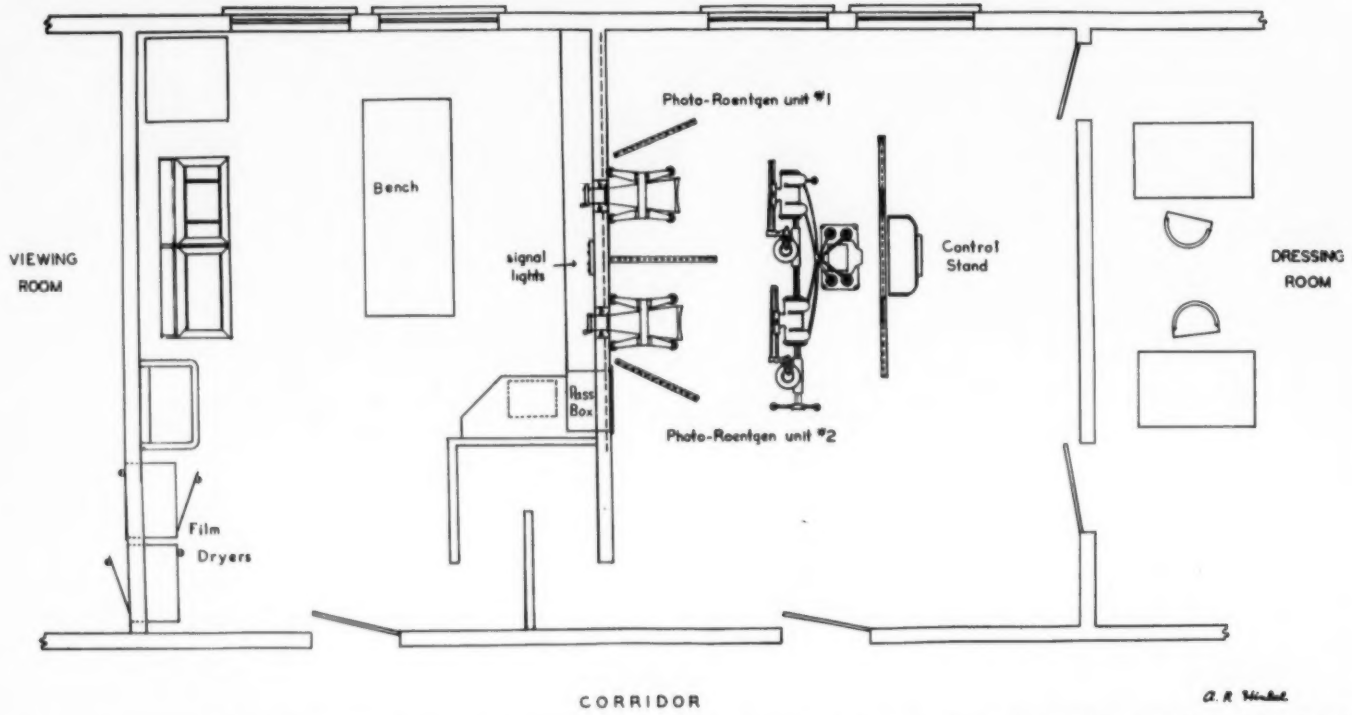

Fig. 2. Arrangement of two photoroentgen units. The capacity of a single x-ray generator can be doubled by switching the output first to Unit 1 and then to Unit 2.

often occurs, and it is therefore difficult to predict whether or not an increase in these trunk shadows is present. Similarly the cardiac shadow itself, because of the 36- to 40-inch screen-target distance, may appear to be enlarged when actually this is not the case.

CONCLUSIONS

1. Technic for the rapid processing of 4 × 10-inch stereoscopic films of the chest is described.

2. Although the detail in these films is considerably less than the best attainable on 14 × 17-inch films, and little can be said about heart size because of the short target-screen distance, the films are, nevertheless, more satisfactory than might be expected for the purpose of finding active tuberculosis in mass examinations.

In the accompanying tables a large number of cases which were examined with single 14 × 17-inch film are compared with large groups of similar individuals examined stereoscopically with 4 × 10-inch film in the photoroentgen unit. The percentage of active cases of tuberculosis discovered was a little higher with the stereoscopic 4 × 10-inch films.

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A Study of the Limiting Diaphragm Method of Collimation[1]

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DURING RECENT studies on the distribution of radiation in a phantom it was observed that the doses in the peripheral region of the x-ray beam were 20 to 30 per cent lower than the doses in the central axis at the same level. The distribution of radiation was also asymmetrical, the variations being greater on one side of the field than the other. (While these facts have been observed by others, they are frequently overlooked.) The measurements were made in a pressed wood (masonite) phantom with a thimble type ionization chamber. X-rays generated at 200 kv.p. with a half-value layer of 1.15 mm. copper were collimated by means of a cone with a limiting diaphragm, 28.5 cm. from the target, designed for a field size of 10 × 15 cm. at 80 cm. target-surface distance. The term limiting diaphragm, as used in this article, refers to a diaphragm placed close to the target for the purpose of limiting the x-ray beam to a specified field at a specified target-surface distance.

A roentgenogram (Fig. 1) of the field irradiated by this cone showed a large central dark area and a narrow peripheral light area, which together made up the total field size of 10 × 15 cm. The dark area was eccentric with respect to the entire field.

Fig. 1. Roentgenogram from a cone with a limiting diaphragm, showing the peripheral light area and the central dark area.

In order to determine the relation of the limiting diaphragm of the cone to the light and dark areas of the irradiated field, a lead wire was placed diagonally across the aperture of the diaphragm, fitting it exactly. A roentgenogram (Fig. 2) then revealed that the wire extended across the entire field, including both dark and light areas, thus indicating that the aperture of the limiting diaphragm was correct for the specified field size.

[1] From the Radiotherapy Service of Dr. William Harris, The Mount Sinai Hospital, New York. Presented before the New York Roentgen Society, Dec. 15, 1941. Accepted for publication in May 1942.

The projection of the wire on the roentgenogram appeared as three parallel bands, the middle one of which was darker than the other two. This observation suggested, as an explanation of the dark and light shadows, the analogous phenomena of umbra and penumbra in ordinary shadows cast by an opaque object in the path of a beam of light. A penumbra is a partial shadow at the edge of the umbra or complete shadow. It is formed when the source of light is a surface and not a point, the beam of light consisting of light rays originating from every point on the surface. If the source of light is a single point, no penumbra is formed, and the shadow consists only of umbra.

Fig. 2. Roentgenogram from the same cone as in Fig. 1 after the addition of a wire in the aperture of the limiting diaphragm, showing the projection of the wire as three parallel bands throughout the entire field.

In a limiting diaphragm, the size of the aperture is generally calculated on the assumption that the x-rays originate from a single point source. The formation of a penumbra with x-rays, as shown in Figure 2, indicates that the source of radiation cannot be considered a single point. A roentgenogram of the target (Fig. 3) made with a pin-hole camera reveals a focal area, 1.5 × 1.0 cm. in size. The x-ray beam is the summation of the radiation from every point in the focal area. Furthermore, since the entire target and its stem appear on the roentgenogram, part of the x-ray beam consists of off-focus radiation originating from the remainder of the target and its stem.

The formation and size of the umbra and penumbra may be illustrated by a diagram (Fig. 4) showing the course of the rays through the aperture of the limiting diaphragm. This diagram indicates that every beam of x-rays collimated by means of a limiting diaphragm consists of umbra and penumbra. This deduction was confirmed by roentgenograms made from a large number of cones, all of which were constructed with limiting diaphragms. Roentgenograms from three cones with the same size field, 6 × 8 cm., but constructed for 50, 60, and 80 cm. target-surface distances, showed progressive increase in penumbra and decrease in umbra with the longer target-surface distances. The target-diaphragm distance for this series of cones was 28.5 cm. The width of penumbra depends upon the width of the focal area on the target and also upon the ratio of the target-diaphragm to target-surface distance. The smaller this ratio, *i.e.*, the closer the diaphragm to the target,

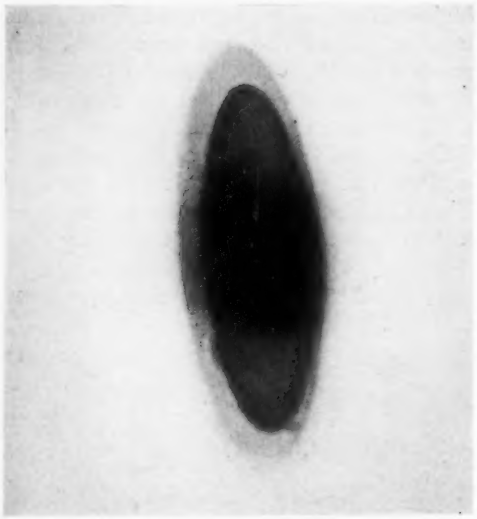

Fig. 3. Roentgenogram of the target made with a pin-hole camera, showing entire surface of target in addition to the rectangular focal area.

the wider the penumbra. The penumbra is also wider on the cathode side of the field because of the angulation of the target.

Errors in construction can occur with limiting diaphragms and, unless looked for, may be missed by the radiologist. In Figure 5, the error is the inaccurate alignment of target, limiting diaphragm, and portal. In some types the aperture is too small, and in some it is too large, for the specified field size. In Figure 6, the limiting diaphragm designed for a field size of 10 × 15 cm. was incorrectly placed in the cone.

Removal of the limiting diaphragm eliminates the phenomena of umbra and penumbra. This is confirmed by roentgenograms made with the same cone with and without the limiting diaphragm.

Effect of Limiting Diaphragm on Output of Radiation: If a limiting diaphragm is used, the output at any given target-surface distance varies with the size of the portal, decreasing with the smaller field (Table I). If the limiting diaphragm is removed, the maximum r rate is obtained and is practically the same (as measured in air) for all the cones of the same target-

TABLE I: RELATION OF SIZE OF PORTAL TO OUTPUT OF RADIATION
(Output without limiting diaphragm = 100)

Size of Portal	Target-Surface Distance	Output with Limiting Diaphragm
6 × 8 cm.	50 cm.	91.0
	80 cm.	86.0
10 × 10 cm.	50 cm.	92.2
	80 cm.	90.0
15 × 15 cm.	50 cm.	95.5
	80 cm.	92.5

Target-diaphragm distance = 28.5 cm. for all cones.

surface distance. The reduction in output depends upon the size of the aperture in the limiting diaphragm (Table II), the

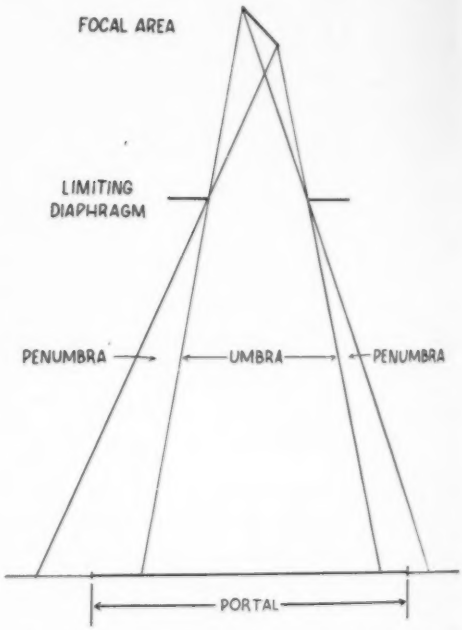

Fig. 4. Diagram illustrating the formation of umbra and penumbra in an x-ray beam collimated by a limiting diaphragm.

smaller aperture probably cutting off more of the off-focus radiation. Conversely, if each cone constructed with a limiting diaphragm is calibrated individually, removal of the limiting diaphragm results in an increase in output. In principle, these results are in agreement with those of Quimby and Marinelli, who also observed an increase in output on removing

Fig. 5. Roentgenogram showing the eccentric position and reduction in size of the effective field due to the inaccurate alignment of the target, limiting diaphragm, and portal.

the limiting diaphragm. These investigators found the increase to be the same for fields of all sizes, whereas in our experiments the increase was greater with the smaller fields.

TABLE II: RELATION OF SIZE OF APERTURE IN LIMITING DIAPHRAGM TO AMOUNT OF REDUCTION IN OUTPUT OF RADIATION

Size of Portal	Target-Surface Distance	Size of Aperture	Reduction in Output
6 × 8 cm.	50 cm.	3.42 × 4.56 cm.	− 9.0%
	80 cm.	2.14 × 2.85 cm.	−14.0%
10 × 10 cm.	50 cm.	5.70 × 5.70 cm.	− 7.8%
	80 cm.	3.56 × 3.56 cm.	−10.0%
15 × 15 cm.	50 cm.	8.55 × 8.55 cm.	− 4.5%
	80 cm.	5.35 × 5.35 cm.	− 7.5%

Effect on Depth Dose: The use of a limiting diaphragm as the method of collimation results in a diminution of depth dose which is most marked in the peripheral region of the irradiated volume. For any given set of physical factors, the depth dose measured in the peripheral region of an irradiated volume is at a

Fig. 6. Roentgenogram showing the marked reduction in the size of the field due to incorrect placement of the limiting diaphragm in the cone.

maximum when the limiting diaphragm is removed. When a limiting diaphragm is used, the peripheral depth dose is reduced by 10 to 30 per cent of this maximum value; the doses in the central axis of the irradiated volume, on the other hand, are

TABLE III: EFFECT OF METHOD OF COLLIMATION ON DEPTH DOSE

Depth in Phantom	Doses with Limiting Diaphragm			Doses without Limiting Diaphragm		
	Distance from central axis			Distance from central axis		
	0 cm.	2 cm.	4 cm.	0 cm.	2 cm.	4 cm.
0 cm.	100.0	96.3	69.0	100.0	98.3	93.5
2 cm.	90.2	86.8	64.6	93.4	91.4	85.4
5 cm.	71.7	69.0	53.6	72.1	70.2	62.7
10 cm.	40.3	38.4	32.0	41.1	40.0	36.8

Physical factors: 200 kv.p., H.V.L. 1.15 Cu, target-surface distance, 80 cm., field 10 × 15 cm. Pressed wood (masonite) phantom, measurements made in 10 cm. axis.

only slightly reduced. The results of depth dose measurements with and without

the use of a limiting diaphragm are indicated in Table III. The explanation for these differences in peripheral depth doses lies in the fact that, with a limiting diaphragm, the peripheral portion of the incident beam consists of penumbra and is therefore, to begin with, of considerably diminished intensity compared with the central portion of the beam. Consequently, the depth doses in the periphery of the irradiated volume will be correspondingly diminished. The method of collimation is therefore of practical importance in the determination of depth dose. This information is frequently omitted in published isodose charts.

Effect on Quality of Radiation: The effect of the limiting diaphragm on the quality of radiation was investigated by an absorption experiment. The intensity of radiation at a point 8.5 cm. below the portal of a cone, in its central axis, was first measured with and without the limiting diaphragm. An arbitrary thickness of filter, 0.75 mm. copper and 1.0 mm. aluminum, was then attached to the under-surface of the portal, and measurements with and without the limiting diaphragm were again taken. The reduction in intensity for each method of collimation was determined. The results indicate no practical difference in quality.

DISCUSSION

The practical significance of this study may be illustrated by the clinical use of a cone constructed with a limiting diaphragm for a field 6 × 8 cm. in size at 80 cm. target-surface distance. The roentgenogram made with this cone reveals an effective field, *i.e.*, the umbra, of about 4 × 6 cm., eccentrically placed. If the output at the portal of this cone is not measured directly but is calculated on the basis of the calibration of another cone, as is often done, then the calculated output may be as much as 16 per cent higher than the real output. If this cone is used without knowledge of these facts in, for example, the treatment of carcinoma of the larynx, the result may be serious under-dosage.

Non-uniformity of the x-ray beam with variations in dose distribution of about the same order observed in our experiments was also reported by Jacobson. She attributed the non-uniformity to faults in the construction or positioning of the target, tube, tube head aperture, master cone, and the limiting diaphragm in cones. In our studies it appears that the major fault lies in the limiting diaphragm.

The disadvantages of the limiting diaphragm as a method of collimation of the x-ray beam may be summarized as follows:

1. Non-uniformity and asymmetry of dose distribution over the irradiated field.
2. Marked diminution of surface and depth doses in the peripheral region of the irradiated volume as compared with the doses in the central axis at the same level.
3. Variations in output for different sizes of field.

The purpose of a limiting diaphragm usually is to limit the size of the x-ray beam close to the target so that the emergent beam of x-rays fills exactly the specified field at the specified target-surface distance. The fundamental fault of this method of collimation is the formation of penumbra. If the aperture of the limiting diaphragm is enlarged sufficiently, the specified field size can be made to consist only of umbra. The major disadvantages of the limiting diaphragm method would then disappear. Then, however, the limiting diaphragm is no longer limiting, since with such a modification the size of the x-ray beam is increased beyond the limits of the specified field size. To eliminate the portion of the beam extending beyond the specified field, a cone with side walls of lead or other heavy metal is required. The same result can be obtained more simply by eliminating the diaphragm entirely and using only a cone with lead-lined walls for collimation of the x-ray beam. The advantages of this method of collimation may be summarized as follows:

1. The beam is uniform, there is no penumbra. A roentgenogram reveals a homogeneous shadow, sharply defined for the specified field size.

2. The maximum peripheral doses on the surface and in the depths of a phantom are obtained (Table III). The result is a more uniform distribution of dose over an irradiated field. The beam is sharply defined within its geometric outline in the phantom. The type of isodose chart obtained is illustrated in a recent publication by Braestrup and the authors (3).

3. The output for any target-surface distance is independent of the size of field, and is slightly greater than if a limiting diaphragm were used.

NOTE: Commercial cones from three nation-wide manufacturers of x-ray equipment were studied. The cones from two of these were constructed with limiting diaphragms and showed all the disadvantages described. In cones from the third source lead-lined walls were used without limiting diaphragms and the cones were satisfactory.

The authors wish to acknowledge their indebtedness to Mr. Carl B. Braestrup for his invaluable assistance and guidance in this work.

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A Roentgenologic Aspect of Pseudomyxoma Peritonaei[1]

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A SURVEY OF THE medical literature fails to reveal any case in which the diagnosis of pseudomyxoma peritonaei has been or could have been made roentgenologically. Recently one case of pseudomyxoma peritonaei was encountered in which it appeared, in retrospect, that the diagnosis could have been made by the radiologist. This case will be presented. Shortly after this a diagnosis of pseudomyxoma peritonaei was ventured on the basis of a roentgenogram of similar appearance. This second case will also be described in detail, as it presents an interesting problem in differential diagnosis.

Pseudomyxoma peritonaei is a rather unusual condition, in which masses of gelatinous or myxomatous material are distributed over the surface of the peritoneum in the form of multiple cysts of varying size or, rarely, as a homogeneous "icing" over the peritoneum. There is an associated chronic peritonitis characterized by thickening of the peritoneum, with dense peritoneal adhesions. The source of this condition is usually a pseudomucinous cystadenoma of the ovary or a mucocele of the appendix. Cases have been reported originating from the cecum or from the remnants of the omphalomesenteric duct.

Randall pointed out that pseudomyxoma peritonaei is not a disease entity but rather a sequel of cystic disease of the aforementioned structures. The rupture of a pseudomucinous cystadenoma, for example, releases a large quantity of pseudomucinous material into the abdominal cavity. This is picked up by the peritoneal lymphatics and these spaces, blocked by the thick, gelatinous material, become distended and rupture. This foreign body peritonitis results in infiltration and fibrosis, the peritoneum ultimately becoming thickened and adherent. At the same time tumor cells are implanted on the peritoneum throughout the abdomen. These tumor cells proliferate and in turn produce pseudomucinous material. Daughter cysts are formed and these again may rupture. It is a combination of the lymphatic reaction to the pseudomucinous material and the implantation of tumor cells with further elaboration of pseudomucinous material that causes the condition called pseudomyxoma peritonaei. In a general way, pseudomyxoma peritonaei is the same, no matter what the source. It is true, however, that the type originating from the ovary is usually more diffuse than that coming from the appendix.

We are not concerned here with the symptoms produced by this condition but it may be stated briefly that these are due primarily to the pressure resulting from the great mass of cystic material filling and distending the abdomen. Early in the condition there are no symptoms, except for abdominal enlargement, usually observed by the patient. Late in the process the most common complication is intestinal obstruction, resulting from the extensive chronic peritonitis.

There is no satisfactory treatment for the condition once it has become established. Surgical treatment consists merely in the removal of as much of the pseudomucinous material from the abdomen as is possible. Intestinal obstruction usually is treated by conservative measures, since by the time it occurs operation is extremely difficult or impossible. Roentgen therapy is often used in an endeavor to produce some regression of the process or at least to arrest it temporarily. As one would expect in such tissue, which is either benign or of low-grade malignancy, benefit is slight and temporary, if indeed it is observed at all. Taylor stated that "in cases of pseudomyxoma peritonei arising from the ovary,

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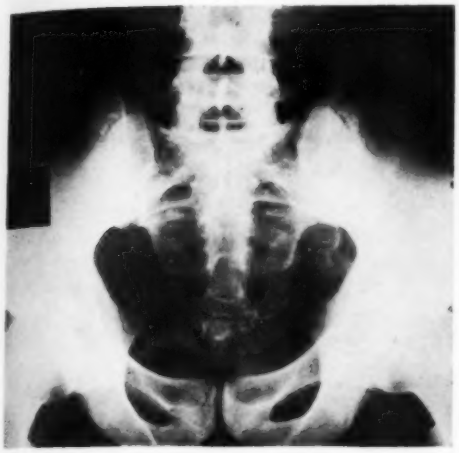

Fig. 1. Case 1. Proved pseudomyxoma peritonaei.

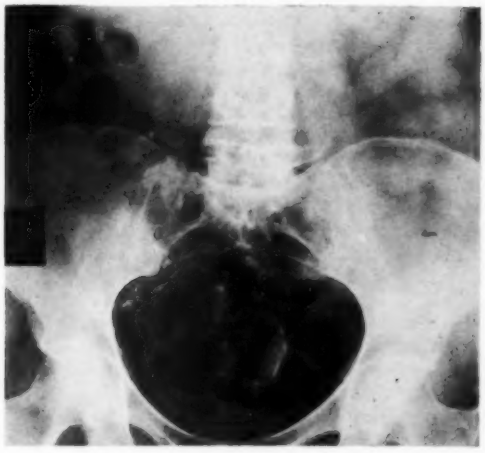

Fig. 2. Case 2. Probable peritoneal paraffinoma.

roentgen therapy may be attempted, but any effect must be regarded as unlikely, due to the probable resistance to irradiation to be expected in these differentiated tumors."

REPORT OF CASES

CASE 1: A man aged thirty-two years was admitted to the Mayo Clinic on May 29, 1941. In January he had first noticed enlargement of his abdomen, though he had no pain nor any other symptoms. Gradually his abdomen became larger. About May 1, peritoneoscopy was performed and at that time a thick gelatinous exudate which appeared like "goose grease" was observed. His physician said that the only thing that he could suggest was a "tumor of the appendix." The patient had no other symptoms but he had lost ten pounds (4.5 kg.) in the month before admission to the clinic.

The results of physical examination were negative except for the abdominal enlargement with multiple small masses palpable in the abdomen and pelvis. The results of laboratory examinations were essentially negative. Roentgen examination of the colon revealed a diffuse narrowing of the rectum due, not to a primary lesion of the rectum, but to some extrinsic process encircling it.

On May 5, 1941, a biopsy specimen, consisting of a small nodule from the region of the umbilicus, was found to be pseudomyxoma peritonaei. This diagnosis was confirmed at laparotomy on June 10, 1941, when an effort was made to remove the mucinous material. This was found to be impossible, however. Postoperative roentgen therapy was given but the response is not known.

Comment: A review of the roentgenograms (Fig. 1) in this case reveals an interesting condition. There are many annular shadows of calcification throughout the abdomen. These are especially distinct in the pelvis, where they are also of greatest size, but there are very small round shadows of increased density even up in the epigastrium. All through the abdomen, but most distinct in the upper part, are shadows of large masses of soft tissue. The annular shadows result from calcification in the walls of numerous pseudomucinous cysts. The masses of soft tissue also represent cystic material with probably adherent loops of small bowel casting their shadows, too.

CASE 2: A woman aged fifty years was first admitted to the clinic on March 3, 1938. She had had many abdominal operations. An appendectomy was performed in 1907 and drainage of an abdominal abscess in 1908. Three weeks after the latter operation she was operated on again for "adhesions." In 1918 laparotomy had been performed with the removal of one ovary and of a cyst from the other one. Also "some ovarian material was scraped from the spine." At this time a bottle of some substance is said to have been poured into the peritoneal cavity to prevent adhesions. In 1937, because of lumbar backache of two or three years' duration, with occasional vomiting spells, laparotomy was again performed. The surgeon reported: "Upon opening the abdomen we encountered innumerable adhesions and cystic masses of various sizes ranging from the size of a pea to the size of an orange. These were densely adherent to the intestines, omentum, and

abdominal wall. It was impossible to thoroughly examine the upper abdomen because of dense adhesions. I have never seen an abdomen in which the organs were more completely matted together than in this case. Distended lymphatics were noted. We finally succeeded in getting our hands down into the pelvis and succeeded in freeing what we thought to be a fibroid but found instead a cystic mass filled with a gelatinous whitish material having the consistency and appearance of vaseline. From the appearance of the abdomen we concluded that the condition in the upper abdomen was due to collections of this same material and as it was impossible to remove it entirely we closed the abdomen."

The pathologist's report reads: "Cystic structure containing inflammable, meltable foreign substance."

Since the last operation the patient has had increasing pain in the back and abdomen. She has had several attacks of intestinal obstruction which have been relieved by conservative measures. Several courses of roentgen therapy have been given. At first she seemed to get some relief from her backache as the result of this treatment but recently irradiation has produced no benefit. Surgical treatment seems now to be contraindicated

Comment: The question is whether this second case is one of pseudomyxoma peritonaei or of peritoneal paraffinoma. There are certainly many things in favor of the latter. It is known that some foreign substance was poured into the abdomen and that the pathologist found meltable, inflammable material in the tissue that he examined after the most recent operation. We know that mineral oil will produce, in many cases, chronic chemical peritonitis. On the other hand, the surgeon who poured in the foreign material also stated that some ovarian tissue was removed from the spine. The cysts were much larger than those usually found in peritoneal paraffinoma, as it is described by Cruickshank. There was some response to roentgen therapy at first, which one might expect from a relatively radioresistant neoplastic process; no such benefit would be expected in peritoneal paraffinoma. The process was extremely diffuse; in fact, it was more diffuse than one would expect in a case of paraffinoma and also seemed to be progressive in character. It is interesting to speculate whether this might not be a case of pseudomyxoma peritonaei complicated by paraffinoma.

The roentgenogram (Fig. 2) in this case reveals an appearance very similar to that in the proved case of pseudomyxoma peritonaei. There are many annular shadows of calcification throughout the abdomen, especially in the pelvis. Numerous large masses of soft tissue are also visible.

GENERAL COMMENTS

A review of all the cases of pseudomyxoma peritonaei seen at the Mayo Clinic from 1935 to 1941 fails to reveal any other case in which there was calcification similar to that described in Case 1. In only 4 of 14 cases, however, including Case 1, were roentgenograms of the abdomen taken.

It seemed, at first, that the roentgenographic appearance produced by pseudomyxoma peritonaei was, when it occurred, unique and diagnostic of that condition. It appears likely, however, that a similar picture may occur in peritoneal paraffinoma. This is as one might expect, since in each case the process is chronic and is characterized by numerous cysts throughout the abdomen. The deposition of calcium is merely a secondary change which we know to occur in many cysts all over the body. *It is only because of the multiplicity of the cysts and their wide distribution that the picture becomes diagnostic.*

I can think of no other condition that would produce an identical appearance. If observations are not made with care, these calcified cysts might be confused with cross-sections of extensively calcified abdominal and pelvic vessels. This mistake should not be made. It seems to me that echinococcus cysts could be differentiated, although this might be difficult at times. Multiple uterine fibroids show a different type of calcification. The calcification in ovarian cysts is identical, but these are never so numerous nor so widely distributed.

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Cardio-Angiography[1]

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FIFTEEN PATIENTS were studied by standard methods of cardiac examination, namely: electrocardiography, the stethogram, venous pressure determinations, circulation tests, kymography, and teleroentgenography. To these methods was added cardio-angiography recently described by Robb and Steinberg (1, 2, 3).

Visualization of structures by means of contrast substances opaque to the roentgen ray is of value as an aid in diagnosis and as corroborative or confirmatory of other clinical findings. Filling of the heart chambers and great vessels permits differentiation between the dilated and the hypertrophied heart or may indicate the existence of both. It reveals the presence of vascular anomalies and morphological changes.

The present conception of the position of the various components of the heart on a roentgen film, in the various positions, is based upon postmortem studies and examinations made upon cadavers with the heart and vessels injected with a radio-opaque substance. This does not take into consideration the actual position of the heart, hemodynamics, muscle tonus, or the results of pressure or force attending the injections. That the position of the heart chambers *in vivo*, in the normal or abnormal heart, is not in complete accord with textbook descriptions has been the observation of one of us (H. K. T.) who has visualized the cardiac chambers in approximately one hundred patients (totalling over 200 injections).

Of the group of 15 patients in whom the present studies were made, 4 had rheumatic heart disease, 1 coronary thrombosis, 2 hypertension, 2 arteriosclerotic heart disease, 3 syphilitic heart disease, and 3 bronchial asthma.

METHOD

A 70 per cent Diodrast solution[4] was used as the contrast agent. This solution is non-irritating, non-toxic, radio-opaque, and quickly eliminated. The technic used was essentially that described by Robb and Steinberg. Five drugs were employed for the determination of the circulation time, *viz.*, ether (4, 5), macasol (6),[4] decholin (7, 8), sodium cyanide (9), and saccharine (10).

RESULTS

The precise time for the radiographic exposure following the injection of the contrast substance is calculated from the results of the circulation tests. In 13 of the 15 cases, the circulation time of the right heart was approximately five seconds or less; in 2 it was prolonged to eight seconds (Table I). The tests were made using a 12-gauge needle attached to a syringe with a large bore. This permitted very rapid injection of the drug. As determined by ether, the normal circulation time for the right heart is three to eight seconds. With the large bore needle and syringe, our results were five seconds or ess. The right heart was best visualized two to three seconds after the beginning of the injection.

[1] Accepted for publication in June 1942.
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[4] We wish to express our thanks to the Winthrop Chemical Company for supplying the Diodrast, and to the Nepera Chemical Company for supplying the Macasol.

TABLE I: RESULTS OF CARDIO-ANGIOGRAPHY AND OTHER DIAGNOSTIC PROCEDURES IN FIFTEEN CASES

Case	Age	Sex	Diagnosis	Stethographic Findings	EKG	Cardiac Ratio	Venous Pressure		Circulation Time	
							Normal	After Held Inspiration	Rt.	Lt.
1	56	M	Bronchial asthma	Systolic at apex		2.0	60	158	4.0	8.5
2	43	M	Bronchial asthma			2.0	48	48	4.5	11.5
3	62	M	Bronchial asthma; emphysema			2.0	30	30	8.0	15.0
4	28	M	Rheumatic heart disease	Diastolic at apex. Diastolic at aorta		1.6	42	70	4.8	12.9
5	22	M	Rheumatic heart disease	Systolic and diastolic at apex. Diastolic at aorta	L.A.D.*	1.75	67	97	5.2	9.0
6	58	M	Rheumatic heart disease	Pre-systolic apical murmur		1.6	74	85	3.5	11.2
7	26	F	Rheumatic heart disease	Pre-systolic at apex		1.8			3.8	10.6
8	54	M	Syphilitic heart disease	Systolic murmur at apex	L.A.D.*	1.5	48	65	5.4	21.9
9	44	M	Syphilitic heart disease	Systolic and diastolic in aortic area		1.4	145	174	4.7	26.5
10	56	M	Syphilitic heart disease; aneurysm	Systolic and diastolic at apex and in aortic area	L.A.D.*	1.4	264	264	8.2	
11	53	M	Hypertensive heart disease	Systolic murmur at apex	L.A.D.*	1.5	120	175	4.5	21.9
12	46	M	Hypertensive heart disease	Systolic murmur at apex	L.A.D.*				3.8	11.3
13	50	M	Coronary thrombosis		L.A.D.*	2.2	100	140	2.5	8.9
14	74	M	Arteriosclerotic heart disease		L.A.D.*		35	125	4.5	14.5
15	80	M	Arteriosclerotic heart disease	Split second sound	L.A.D.*	1.7	100	100	4.0	14.0

* Left ventricular hypertrophy shown by contrast roentgenography.

The circulation time tests for the left heart were not constant, the time factors showing variations of one or more seconds. At times there was no response to 0.3 c.c. sodium cyanide, particularly if the heart was enlarged. Increasing the amount to 0.5 c.c., and sometimes to 1 c.c., resulted in a good response, a rapid recovery, and no untoward effects. When the circulation time was ten seconds or less, the left side of the heart was best visualized about seven seconds after the beginning of the injection; when ten to twelve seconds, at eight seconds; when twelve to fifteen seconds, at ten and a half seconds. Above fifteen seconds the exposure time was difficult to calculate, and the results were usually poor.

The amount of radio-opaque solution for the average injection was 40 c.c., at times increased to 45 and 50 c.c. in persons with large hearts. Each examination consisted of two injections. In one patient a total of 120 c.c. of the contrast solution was given in three injections of 40 c.c. each, at fifteen-minute intervals with no untoward symptoms. Most patients reacted mildly to the injection. Symptoms were not alarming and subsided in a few minutes. All the patients experienced a flushing of the head and neck and a profound sense of warmth, which disappeared in less than one minute. Cough was induced immediately in some, others complained of nausea, and most of them had profuse salivation. Vomiting occurred in

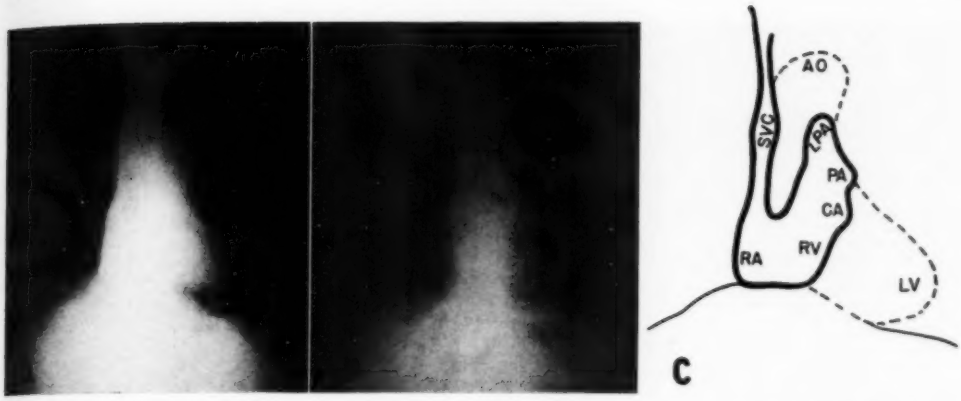
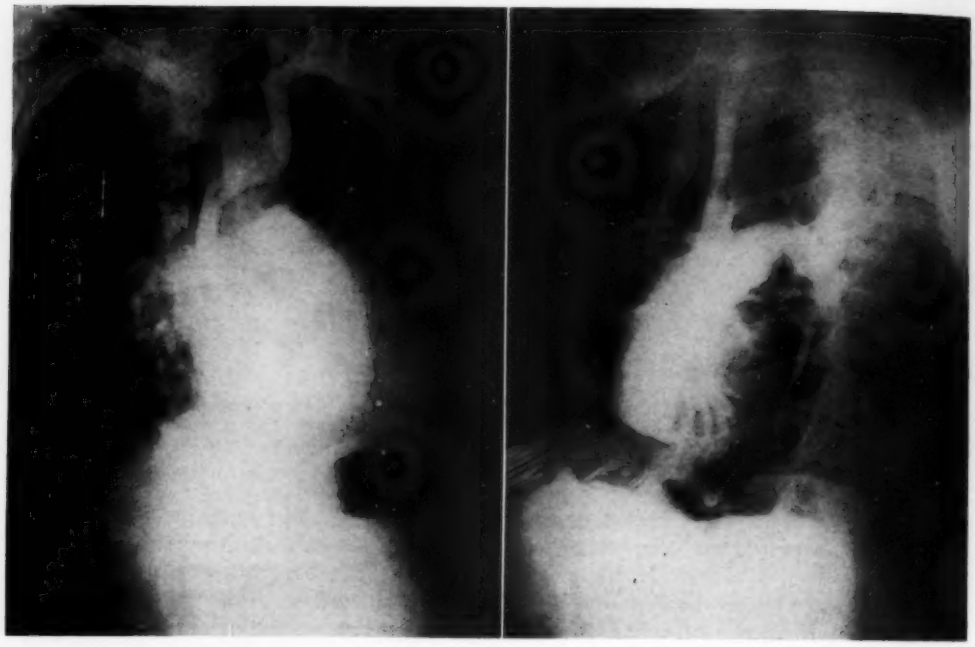


Fig. 1. A. Enlarged right heart. B and C. Normal heart. Postero-anterior projection. Contrast substance in right heart. The superior vena cava, the right heart, and pulmonary aorta assume the shape of a "U" and are situated in the right half of the cardiac silhouette. In normal hearts the left border of the contrast substance is seldom situated to the left of the spine.

those patients who had ingested food prior to the examination. Sweating and urticaria appeared in some. In the majority there was a marked momentary weakness. Despite these symptoms, no patient refused a second injection. The symptoms following the second injection were less severe.

Figure 1A (Case 1, bronchial asthma) is a contrast roentgenogram in the postero-anterior projection; the right heart is outlined. The structures visualized, the superior vena cava, the right auricle and ventricle, and the pulmonary artery, assume the shape of a "U." In 11 of the 15 patients the right heart assumed the same outline when visualized, and did not extend much beyond the left border of the spine. It did not approximate the left border of the cardiac silhouette. The upper half of the right border of the heart shadow is formed by the superior vena cava and the lower half by the right auricle and, occasionally, the inflow tract of the right ventricle. In most of the cases, the diaphragmatic base of the right side is flat. The structure visualized in the middle segment on the left border of the heart is the left branch of the pulmonary artery. The pulmonary aorta is within the cardiac silhouette. Just below the pulmonary aorta is a curved projection, the conus arteriosus, well within the cardiac silhouette. In our cases it did not form any part of the central portion of the left border. The region between the left border of the heart and the conus arteriosus does not fill with contrast substance. It is not visualized in either examination of the right or the left side of the heart. The identification of this structure remains in doubt. Some of the dye can be visualized in the larger branches of the pulmonary arteries. Figure 1B, showing the right heart of a normal person, is included to show the similarity to Figure 1A. The cardiac chambers of the right heart, as well as the large vessels, assume a more or less similar pattern.

Figure 2 (Case 6, rheumatic heart disease with mitral stenosis) is a contrast roentgenogram in the right oblique position. The right heart is "U"-shaped. The superior vena cava merges with an enlarged right auricle. The latter rests upon the right diaphragm and forms the lower third of the vertebral border of the heart shadow. A small indentation at the diaphragmatic border, the coronary sulcus, indicates the beginning of the inflow tract of the right ventricle. The inflow tract merges with the outflow tract, and the distinction between the two is again indicated by a small indentation on the left border of the base of the "U." The continuation of the outflow tract, the pulmo-



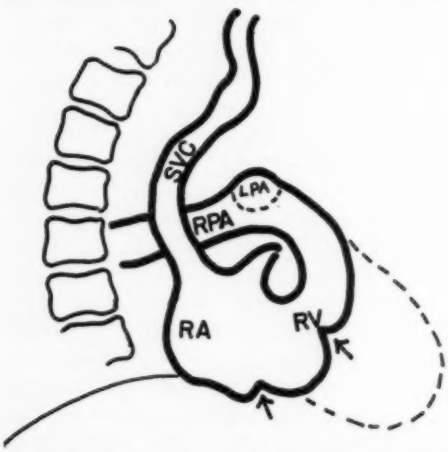


Fig. 2. Right oblique position. Contrast substance in right heart. In this position the structures of the right heart also assume a "U" shape and are situated in the posterior portion of the cardiac silhouette.

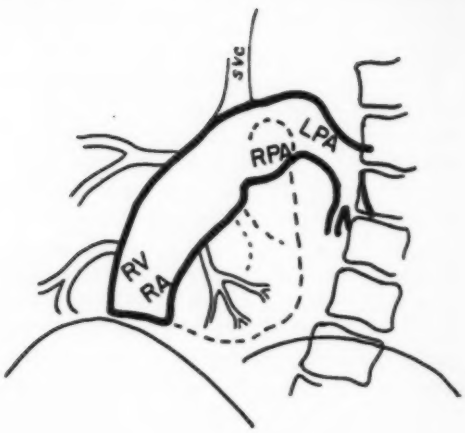
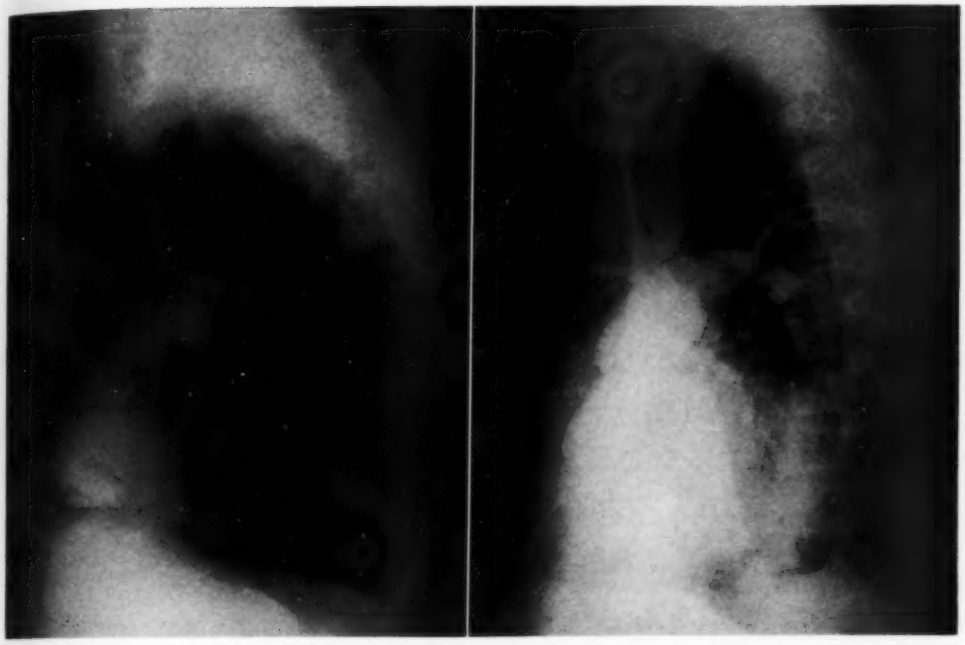


Fig. 3. Left oblique position. Contrast substance in right heart. In this position the structures are superimposed upon one another, and occupy the anterior portion of the cardiac silhouette.

nary vessels, forms the central part of the ventral border of the heart shadow and represents the pulmonary artery and its left branch. The latter appears in cross-section at the uppermost portion of the opaque shadow. Extending dorsally from this point across the vertebral column is a broad opaque band, the right branch of the pulmonary artery. The irregular opaque shadow connecting the two limbs of the "U" is probably the right auricular appendage.

Figure 3 is a contrast roentgenogram of a normal heart in the left oblique position.



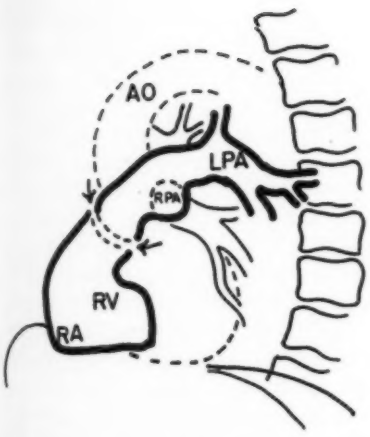


Fig. 4. Left lateral projection. Contrast substance in right heart. The structures are superimposed and occupy the anterior half of the cardiac silhouette. The superior vena cava is situated dorsally. The pulmonary aorta and pulmonary arteries are visualized.

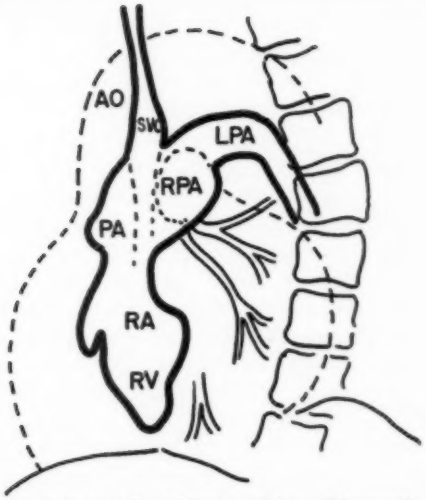


Fig. 5. Left anterior oblique position. Rheumatic and hypertensive heart disease. Contrast substance in right heart. Cardiac enlargement due to marked myocardial hypertrophy, and no chamber enlargement. Verified postmortem.

All of the structures of the right heart are superimposed upon one another. Differentiation of the various component parts is not possible. The right side of the heart is outlined as a broad curved rectangular structure, convex anteriorly, having a flat base and forming the entire ventral border of the heart shadow. The superior vena cava, a straight narrow band of opaque substance, merges with the upper portion

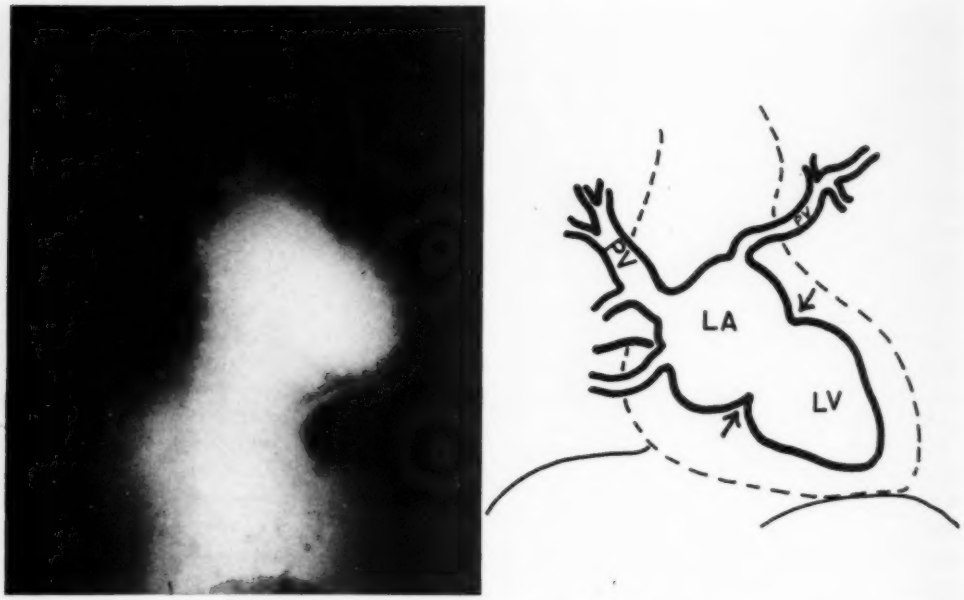


Fig. 6. Postero-anterior projection. Contrast substance in left heart. The left auricle, enlarged and circular in outline, is situated above and to the right of the left ventricle. Constriction in contrast substance indicates demarcation between auricle and ventricle.

of the rectangular shadow. Many pulmonary vessels are outlined with contrast substance. The left branch of the pulmonary artery comes off at a slightly higher level than the right branch and appears angulated. The proximal portion is directed upward and the distal portion is directed downward.

Figure 4 (same case as Fig. 1) is a contrast roentgenogram in the left lateral position. The right auricle and ventricle are superimposed, forming the anterior or ventral portion of the heart, and occupying one half of the heart shadow. The diaphragmatic border of the right heart is horizontal. The superior vena cava descends through the central portion of the cardiac shadow to enter the right auricle. In the upper portion of the opaque shadow is a narrow curved area of decreased density demarcating the origin of the pulmonary artery. The right and left branches of the pulmonary artery are visualized.

Figure 5 (Case 12, rheumatic and hypertensive heart disease) is a contrast roentgenogram in the left anterior oblique position. The contrast substance in the chambers is remote from the periphery and base of the heart shadow. The inference is that the non-outlined portion of the heart shadow between the opaque substance and ventral border and base of heart is hypertrophied muscle. This myocardial hypertrophy was demonstrated at autopsy. The auricle and ventricle cannot be distinguished because of superimposition. This is true in all cases in this position. A slight narrowing demarcates the origin of the pulmonary artery from the right ventricle. The pulmonary artery is dilated and the left branch is elevated, with loss of angulation. The right branch appears in cross-section as a circular area of increased density on the inner border at the bifurcation of the pulmonary artery. The contrast solution is present in many of the pulmonary vessels. The superior vena cava passes through the middle of the shadow of the pulmonary artery and can be traced with some difficulty down into the central part of the posterior border of the opaque

shadow, where it enters the right auricle.

Figure 6 (same patient as shown in Fig. 2) is a contrast roentgenogram in the frontal position. The left auricle and ventricle are visualized. A slight constriction on either side of the opaque shadow demarcates the auricle from the ventricle. The auricle is circular in outline, enlarged, located above the ventricle and in the right portion of the heart shadow. It does not extend to the right border of the heart and is far removed from the left border. The left auricular appendage as such is not recognizable. The contrast also reveals an enlarged left ventricle.

Figure 7 is a contrast roentgenogram, in the right oblique position, of the patient in Figures 2 and 6. The left auricle and ventricle are visualized. The left auricle is enlarged, circular in outline, situated posteriorly in the heart shadow, above and behind the right auricle (Fig. 2), and extends to the anterior border of the vertebral column. It forms part of the posterior border of the heart shadow. The pulmonary veins are visualized entering the left auricle. The left ventricle is elliptical in shape and is separated from the left auricle by an area of constriction, the mitral ring.

In contrast to that which obtains in the right oblique position, Figure 8 (Case 1) is representative of the outline of the left auricle and ventricle in the left oblique position. The relationship with the rest of the heart and adjacent structures is shown in Figures 3 and 4. There is an overlapping to some extent of the auricle and ventricle, making an exact differentiation between the two chambers difficult. The pulmonary veins containing contrast substance are outlined entering the upper and posterior portion of the auricular shadow. The left auricle is situated above and behind the left ventricle and forms the upper portion of the vertebral border of the heart. The left main bronchus passes just posteriorly to and above the pulmonary vein. The left ventricle makes up the posterior half of the heart. The conus of the aorta is visualized well within the contrast mass in contact with the upper

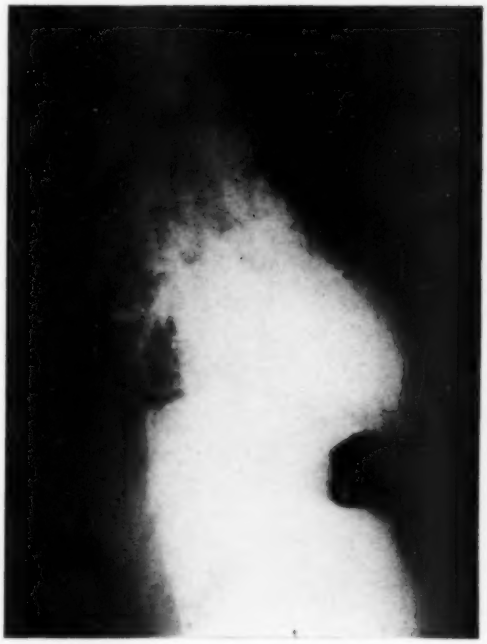
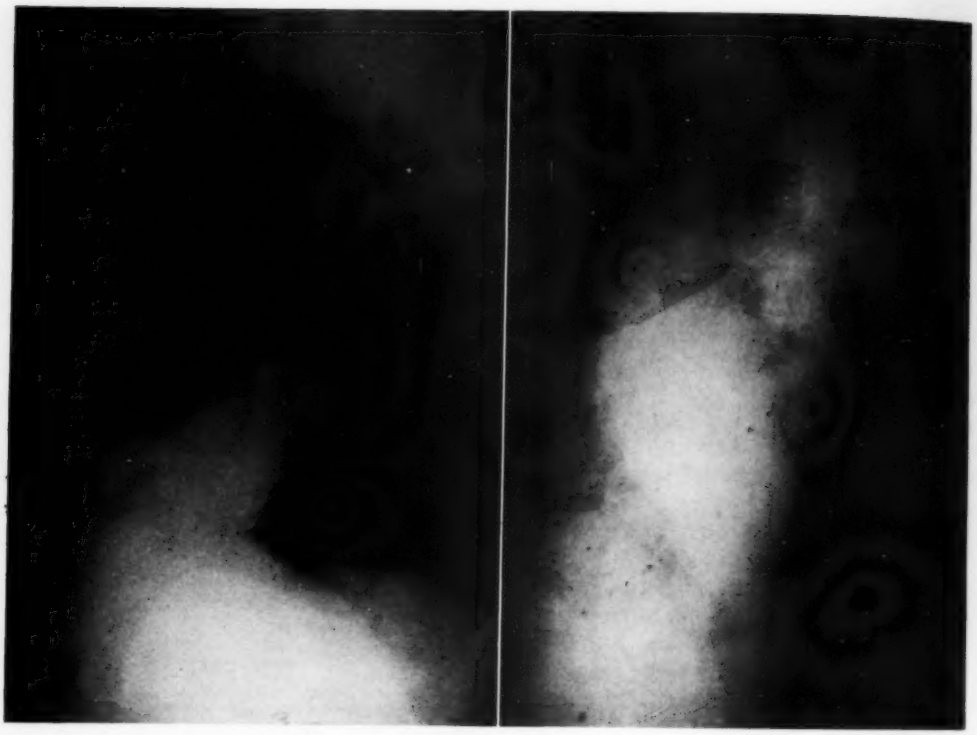


Fig. 7. Right oblique position. Contrast substance in left heart. The left auricle is enlarged, circular in outline, and is situated dorsal to and slightly above the left ventricle. Constriction in contrast substance indicates demarcation between auricle and ventricle.

and anterior portion of the contrast substance representing the left ventricle. The aortic arch and part of the descending aorta are outlined with contrast substance.

Figure 9 (Case 4, rheumatic heart disease, mitral stenosis, and insufficiency; aortic insufficiency) is a contrast roentgenogram in the left oblique position. The left ventricle and aorta appear as one homogeneous opaque shadow. It is impossible to determine the point of origin of the aorta as seen in Figure 8. This lack of differentiation may be evaluated as due to a dilatation of the aortic ring, with insufficiency. The greatest density is in the center of the contrast shadow and is probably due to the fact that the exposure was made during systole, which would account for the poor filling of the left ventricle.

Figure 10 (Case 7, rheumatic heart disease, mitral stenosis, and insufficiency) is a contrast roentgenogram in the left oblique position. The left auricular and



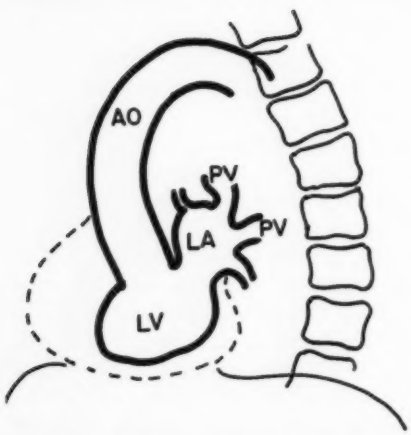


Fig. 8. Left oblique position. Contrast substance in left heart. The structures are partially superimposed and occupy the posterior half of the cardiac silhouette. The arch of the aorta and the origin of the ascending aorta are visualized.

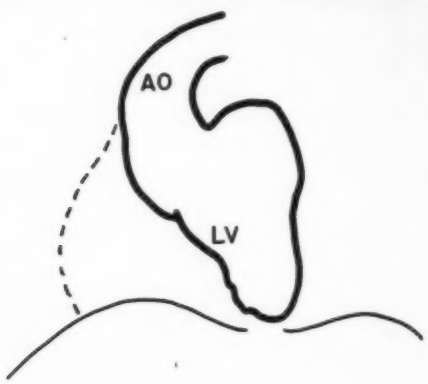
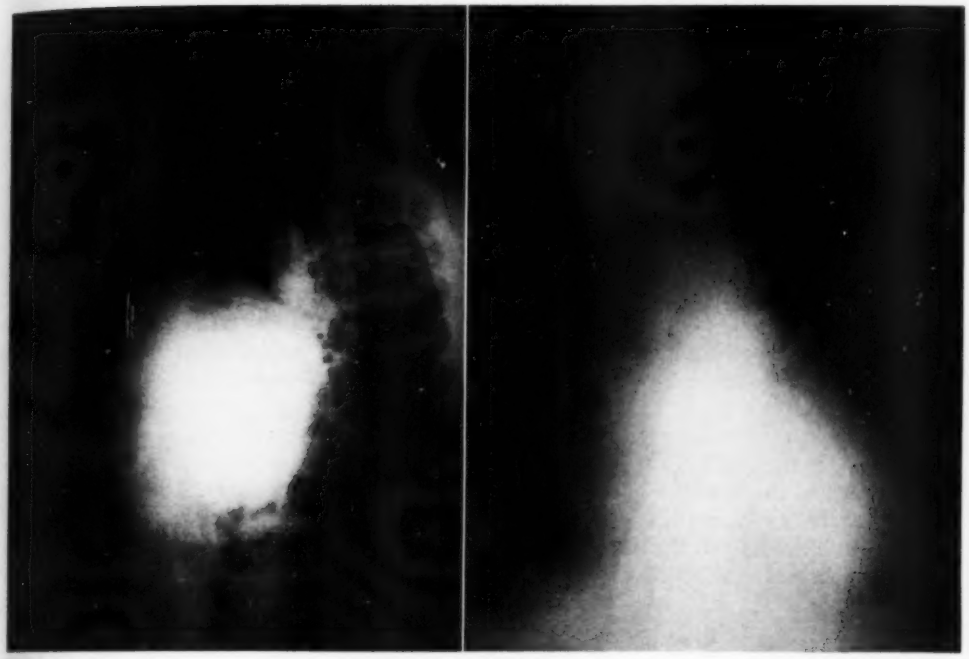


Fig. 9. Left oblique position. Rheumatic heart disease, mitral stenosis, and insufficiency; aortic insufficiency. Contrast substance in left heart. Origin of ascending aorta not clearly visualized. Chambers of left heart are dilated.

ventricular shadow cannot be differentiated. The whole left heart is represented by one mass of contrast substance. This lack of differentiation represents a dilatation of the area of junction between the two chambers. The inference is that the mitral ring is dilated, and mitral insufficiency is present.



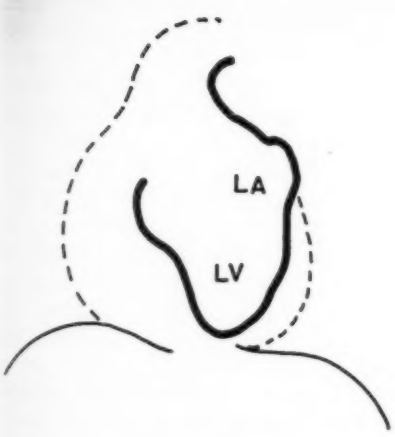


Fig. 10. Left oblique position. Rheumatic heart disease, mitral stenosis, and insufficiency. Contrast substance in left heart. Chambers of heart are dilated. The left auricular and ventricular shadow cannot be differentiated.

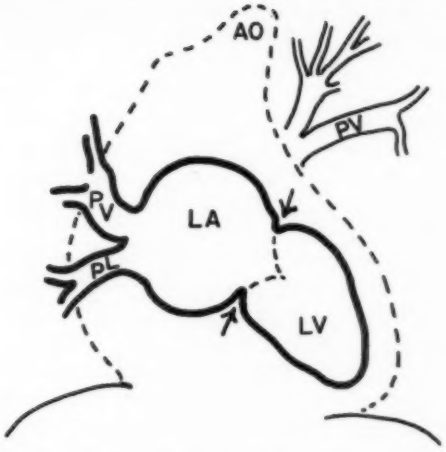


Fig. 11. Postero-anterior projection. Rheumatic and hypertensive heart disease. Contrast substance in left heart. Left auricle enlarged. The chamber of the left ventricle does not appear enlarged. The ventricular wall is hypertrophied.

Figure 11 (Case 12, rheumatic and hypertensive heart disease) is a contrast roentgenogram, in the postero-anterior projection. The left auricle and left ventricle are visualized. The auricle is enlarged, situated in the center and to the right in the heart shadow, but does not extend over to the right border. The heart shadow is greatly enlarged but there is no corresponding enlargement of the

visualized left ventricle. The ventricular wall is thick and is represented by the shadow external to the contrast substance. In this case, hypertrophy is evidenced by the thick wall and a ventricular chamber that assumes a normal outline. In enlarged and dilated hearts, visualization of the chambers is poor. The causes for the poor visualization are an enlarged chamber and an admixture of a large amount of blood with contrast substance, decreasing its density.

The information obtained from cardio-angiography with respect to the different components of the heart cannot be made available by any one or any combination of the routine methods of cardiac examination. Some of the results obtained by this technic were of value in corroborating conclusions drawn from the other methods. Electrocardiograms showing axis deviation were interpreted as indicative of ventricular preponderance or hypertrophy. In the cardiac group, 8 of the 12 cases had a left axis deviation. Cardiac visualization demonstrated a left ventricular hypertrophy in 5 of the 8, no hypertrophy in 2, and in a single case visualization of the left side was poor. This last patient had an aortic aneurysm. The 3 cases of bronchial asthma showed no ventricular hypertrophy, either right or left, no axis deviation, a normal cardiothoracic ratio, and in one instance deviation of the interventricular septum to the left. Recently Sussman, Steinberg, and Grishman (11) have described changes in position of the interventricular septum in the heart in Emphysema, which were present in one of these patients. No conclusions can be drawn from these observations since our series is much too small.

Stethograms graphically recorded cardiac murmurs which as a rule occurred frequently in the left heart, involving the mitral and aortic valves. In valvular disease, the configuration of the heart assumes a certain recognized pattern of enlargement dependent upon the valve or valves affected. Most often one can determine the type of valvular lesion by the cardiac configuration. Cardio-angiography demonstrated the size of the chambers in mitral stenosis (Figs. 6, 7, and 11), mitral insufficiency (Fig. 10), and aortic insufficiency (Fig. 9).

It has been shown that during deep inspiration there is a rise in the venous pressure. It occurred to us that this might impede the flow of contrast solution. Venous pressure studies were made with a Moritz-Tabora apparatus during a held inspiration and the change from the normal reading was noted. Normal venous pressures varied from 30 to 156 mm. of water, except in one patient, who had a pressure of 264 mm. of water (Case 10). The rise during a deep held inspiration varied from 0 to 98 mm. of water (Table I). Our end-results, however, were not affected. The injections were made with sufficient force to overcome the increased venous obstruction resulting from a deep inspiration.

SUMMARY AND CONCLUSIONS

Cardiac visualization is a recent adjunct to the cardiologist's armamentarium. The technic employed demands accuracy, speed, and precision. The circulation tests may be omitted where moving pictures or numerous serial exposures can be made. The position of the various component parts of the heart and the border-forming structures as determined by means of cardio-angiography are not entirely as described in the textbooks. In the postero-anterior and right oblique positions the component parts of the right side of the heart—namely the superior vena cava, the right auricle, the inflow and outflow tracts of the right ventricle, the pulmonary conus, and the pulmonary artery—when outlined form a "U" (Figs. 1 and 2). The questionable middle segment of the left cardiac border may be divided into two portions, an upper and lower. The upper portion is formed by the large vessels. The lower segment, which is in juxtaposition to the base of the left ventricle and is lateral to the conus of the right ventricle, does not fill with contrast substance. What forms this part of the

cardiac silhouette is debatable. It may be the left auricular appendage, even though it was not filled with contrast substance. The conus arteriosus of the right ventricle is well within the left border. The right border from above downward is formed by the superior vena cava, the right auricle, and sometimes the inflow tract of the right ventricle.

In the left oblique position all the component parts that make up the right heart are superimposed upon each other to form a broad rectangular opaque band. This comprises the entire ventricular contour of the cardiac shadow (Fig. 3). The left auricle and ventricle, when outlined, present similar outlines in the frontal and right oblique positions (Figs. 6 and 7). In the frontal position, the auricle is circular in outline, located above the ventricle in the right portion of the heart shadow. In the oblique position, it forms part of the posterior border of the heart above the right auricle. The ascending aorta forms a part of the right border of the cardiac silhouette only when lengthened, dilated, or tortuous. In the left oblique position the left auricle and ventricle are to some extent superimposed. The auricle is above and behind the ventricle, both forming the posterior half of the heart shadow (Fig. 8).

Cardio-angiography is not recommended as a routine procedure in all cardiac patients. It is indicated only in those patients who present unusual cardiac diagnostic problems, and in cases where anatomical anomalies are present or suspected. It is of value in the diagnosis of pericardial effusions, aneurysms of an arterial or ventricular nature, constrictive occlusion and thrombosis of the superior vena cava, and in differentiating cardiovascular from other mediastinal lesions.

We had no serious or untoward reactions in any of our cases. Included were 2 cases in mild congestive failure, hypertensives, one with renal insufficiency and nitrogenous retention, a case of hypertension with bundle branch block, and a case of coronary occlusion. This type of cardiac examination is not recommended in patients who are debilitated, acutely ill, in severe cardiac decompensation, or in those having marked respiratory distress.

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Clinico Pathological Conference[1]

HOSPITAL OF THE PROTESTANT EPISCOPAL CHURCH, PHILADELPHIA, PENNA.

R. P. Barden, M.D., W. P. Belk, M.D., G. E. Pratt, M.D., W. R. Taylor, M.D.

C. D. (Case A40,933), a five-year-old white boy, was first admitted to the hospital in February 1940, with a history of pain in the joints and recurrent fever of seven months' duration. During this time he had been treated for acute rheumatic fever, without improvement. Onset of the pain had been in the right knee and right lower leg, and the knee joint had been moderately swollen and tender. Subsequently, similar episodes occurred involving the other knee and both ankles and elbows. Symptoms subsided after several weeks but recurred in spite of bed rest and salicylates. It was noted that each episode was associated with tenderness along the shafts of the adjacent long bones.

Past history and family history were not contributory.

Physical examination on admission showed a pale, under-nourished, underdeveloped boy with slightly swollen tender knees and elbows. Temperature was 99.8°, pulse 100, and respirations 20. The positive findings were marked pallor of the mucous membranes, a blowing systolic murmur at the cardiac apex, and limitation of motion of the elbows and knees due to pain. There was exquisite tenderness along the shaft of each tibia from the knee to the ankle. There were no enlarged lymph nodes and no abdominal organs or masses could be felt.

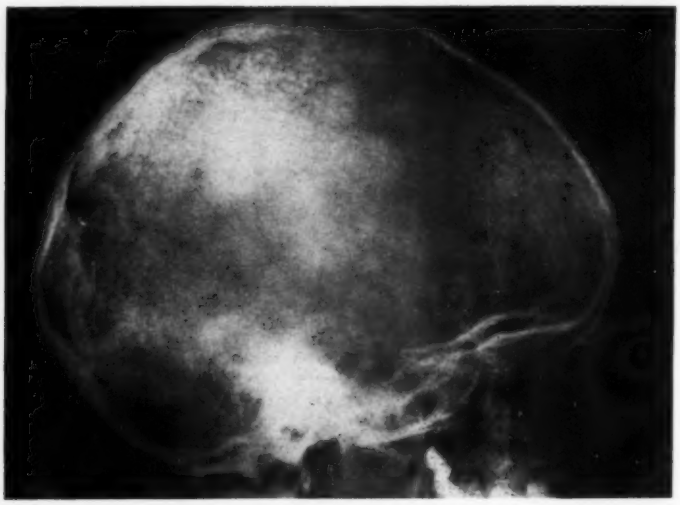
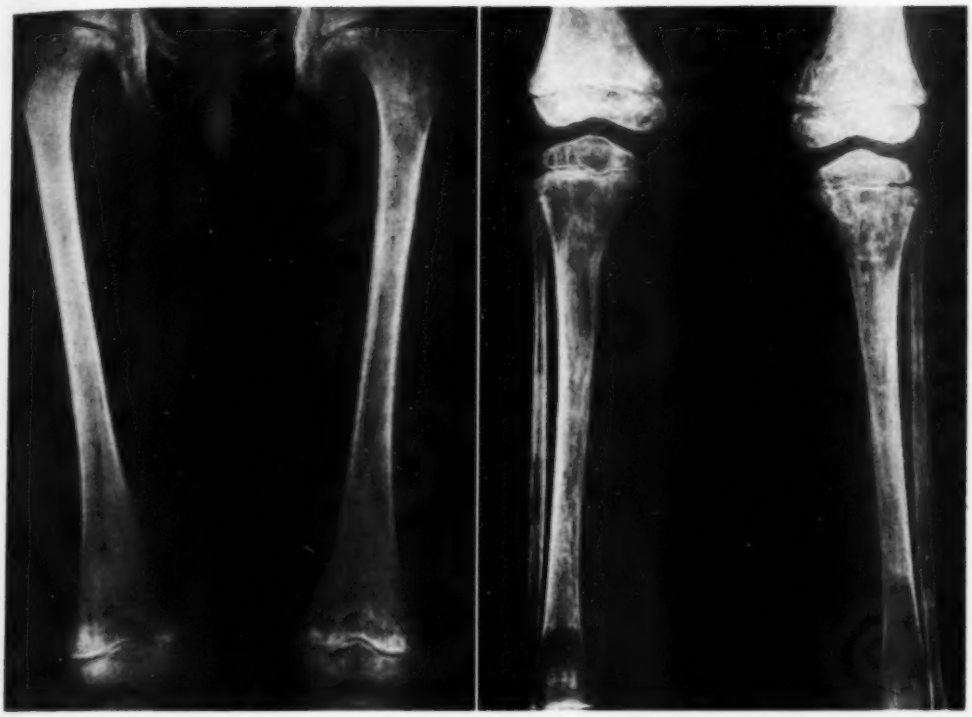


Fig. 1. Lateral film of skull showing evidence of mottling due to innumerable small areas of bone destruction. No evidence of increased intracranial pressure.

Laboratory examinations showed a hemoglobin of 50 per cent (S) with 2,800,000 red blood cells. The white blood cells numbered 2,000, of which 68 per cent were adult lymphocytes. The Wassermann reaction was negative and blood chemistry and urinalysis were normal. A biopsy of the sternal marrow was performed.

[1] This report was prepared by Robert Phelps Barden, M.D.



Figs. 2 and 3. Films of femora and tibiae. The film of the femora (on the left) shows a fine line of periosteal new bone along the upper third of each shaft, with areas of destruction in the diaphyseal portions at the upper and lower ends.

Both tibiae show changes similar to those in the femora but much more pronounced. The periosteal new bone is clearly shown along the lateral aspect of the upper portion of each side. Destruction of the medullary portion is quite extensive, with the most marked lesions at the upper and lower ends.

Roentgen examination of the skeleton showed numerous punched-out areas of rarefaction in the skull, pelvis, and the diaphyses of the femora and tibiae. All the long bones showed a striking, smooth, regular periosteal proliferation extending along the shafts. (Figs. 1, 2, 3.)

During the next two months the patient remained chronically ill, and enlargement of the liver, spleen, and lymph nodes appeared.

Dr. Belk: Before proceeding to a discussion of the differential diagnosis, I think we should be told about therapy, inasmuch as this patient's response to therapy has diagnostic significance.

Dr. Taylor: This little boy was given supportive therapy, including iron and vitamins and numerous small transfusions during the eight months before his death. Roentgen radiation in divided doses totalling 300 r, given with an intermediate-voltage unit, proved specific in relieving bone and joint pain. In addition, small doses (10 r) of whole body irradiation at 70 cm. at weekly intervals seemed to maintain the child in fairly good health during most of the summer before his death.

With the coming of October, the patient began to lose ground steadily in spite of treatment. Subcutaneous ecchymoses and a persistent neutropenia developed. The week before death, the white count was 300 with absence of polymorphonuclears. This agranulocytosis was associated with generalized furunculosis.

Dr. Belk: I would like to have Dr. Barden discuss the roentgenograms in the light of the clinical findings.

RADIOLOGICAL DISCUSSION

Dr. Barden: The roentgen examination shows very extensive skeletal changes involving the flat bones and both the medulla and periosteum of the long bones. While the involvement in the pelvis and skull is diffuse, most of the destruction in the long bones is at the diaphysis. The thin periosteal cuffs of new bone which we see occur as the result of any localized subperiosteal irritant, whether hemorrhage, infection, or neoplasm. Because of the extent of this process the differential diagnosis lies between a blood dyscrasia and diffuse metastatic cancer. In favor of primary disease of the blood-forming organs is the fact that this condition appeared to start as a generalized disease of bone with subsequent involvement of the lymph nodes and spleen. This is further supported by the findings in the peripheral blood, which suggest an aleukemic form of lymphatic leukemia with secondary anemia. The diagnosis of leukemia is weakened, however, by the scarcity of abnormal white cells in the peripheral blood and the late appearance of lymphadenopathy. Of course, the bone marrow biopsy which was taken may help in deciding this question.

The second possibility is that of a diffuse neoplasm. What malignant growth in early childhood is prone to give widespread skeletal changes similar to those shown here? I think that sympathetic neuroblastoma could readily produce this picture. No primary mass was felt in this patient's abdomen, but it is well known that a primary neuroblastoma may be very small indeed. It might be well to mention here that some confusion exists in the literature concerning the differentiation between Ewing's endothelial myeloma and neuroblastoma. Indeed, some pathologists believe the two conditions are identical. Although it is certainly true in this case that any one bone or combination of bones shows changes identical with Ewing's tumor, the multicentric onset is against such a diagnosis.

Radiological Diagnosis: Sympathetic neuroblastoma with extensive skeletal metastases.

PATHOLOGICAL DISCUSSION

Dr. Belk: You have noticed, of course, that the results of the bone marrow biopsy have not been included in the discussion. These smears showed collections of large pale cells, with densely chromatic nuclei, arranged in pavement fashion and corresponding to the description of Ewing's endothelial myeloma. I might say, in passing, that even after this histological examination some of the clinicians felt the whole picture could be better explained on the basis of neuroblastoma.

Postmortem examination showed extensive replacement of bone marrow by fat with scattered masses of tumor cells, many of which were degenerating. The metastatic foci in the subperiosteal region of the long bones were easily identified. A few tumor nodules were found in the liver. The adrenals were normal and no primary abdominal tumor was present. Histologic examination showed the same tumor structure as the bone biopsy.

Pathological Diagnosis: Ewing's endothelial myeloma with extensive skeletal involvement.

Dr. Pratt: I would like to ask one question. The original blood picture misled us into a diagnosis of lymphatic leukemia. Is a leukemoid blood picture often seen with bony metastases?

Dr. Belk: I would not say often. However, in very extensive replacement of bone marrow by tumor, especially in children, it may occur, and should always be considered in the differential diagnosis when the blood picture of so-called aleukemic leukemia is present together with roentgen evidence of extensive destruction of bone.

CASE REPORTS

A Case of Right Aortic Arch[1]

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and SAUL ROSENZWEIG, M.D.
Detroit, Michigan

A little over 100 cases of right-sided aorta have been reported in the literature, but only about 20 or 25 of these have been diagnosed during life. To this short list we wish to add one more case. The condition is known also as dysphagia lusoria (Bayford-Autenrieth), as high right-sided aorta, situs inversus aortae, and transposition of the arch of the aorta.

The first case to be discovered during life was described by Mohr (18) in 1913, and the diagnosis was made by Assmann (2), who reported the roentgen findings. In 1926 Renander (21) recorded the first case in the English literature. The condition has been described also by Garland (9), by Spencer and Dresser (25), Sprague, Ernlund, and Albright (26), Blackford, Davenport, and Bayley (4), Kuhlmann (15), Silvestrini (24), Kejlson and Aronson (13), Friedman (8), Metzger and Ostrum (17), Saupe (23), Paviot, Levrat and Guichard (20), Arkin (1), and others. Biedermann (3) found 12 instances among 20,000 autopsies and 7 cases in 5,000 chest examinations. No doubt many cases have been missed.

In the embryo at five weeks there are five pairs of aortic arches plus a pair of transitory arches caudally, really six pairs of arches. These arches connect the primitive dorsal and ventral aortae. The fourth left branch develops into the normal aortic arch. The common carotid is formed by the ventral roots of the third arch. The external carotid is formed by the first and second roots on each side. The portion of the right dorsal aorta between the subclavian and common dorsal aorta disappears and the remainder of the fourth arch forms the base of the subclavian artery on the right. In the anomaly here considered this development is reversed. The left fourth branchial arch is obliterated, with the exception of a small diverticular sac from which arises the subclavian artery. The communication between the right fourth branchial arch and common dorsal aorta persists, forming the right-sided aorta, which displaces the esophagus and trachea to the left. The diverticular sac lies behind the trachea and esophagus and displaces them forward. Occasionally there may be remains, also, of the left aortic arches, which tend to form a fibrous ring around the trachea and esophagus, increasing the pressure symptoms.

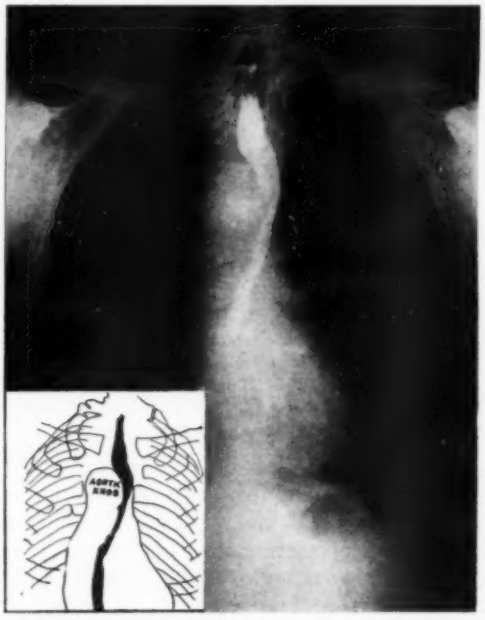

Fig. 1. Posterior-anterior roentgenogram showing aortic knob to the right of spine and the esophagus displaced to the left.

Many cases of right-sided aorta are asymptomatic and are found accidentally

[1] From the Departments of Radiology and Cardiology of North End Clinic, Detroit, Mich. Accepted for publication in May 1942.

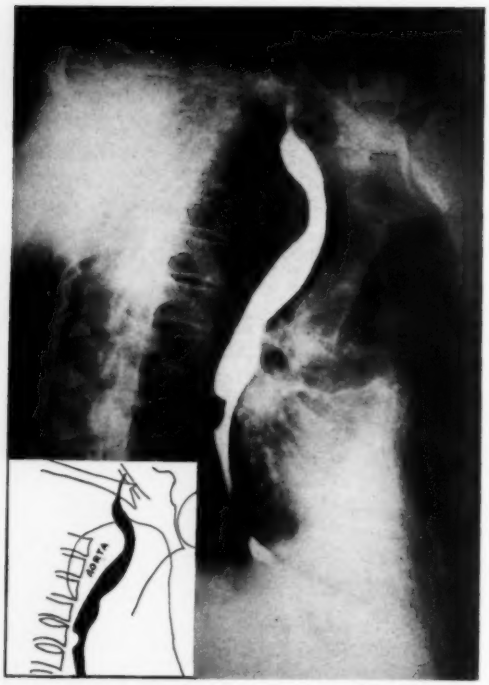

Fig. 2. Right oblique roentgenogram showing anterior displacement of esophagus.

in the course of routine examinations. In some cases, however, where the pressure or constriction is great enough, there are difficulty in swallowing (hence "dysphagia lusoria"), a choking sensation, dyspnea, and cyanosis. These symptoms arise when the blood pressure becomes elevated, usually from emotional stress. Because of this a diagnosis of hysteria or psychoneurosis may be made.

The only possible way to diagnose this anomaly is by roentgenologic methods. It has been frequently missed, however, by roentgenologists, and such diagnoses as mediastinal tumor and Hodgkin's disease have been made, with the result that some cases have been subjected to deep therapy. One of Garland's patients was operated upon for mediastinal tumor.

The x-ray appearance is fairly typical. In the posterio-anterior projection (Fig. 1) one sees the aortic knob to be either absent or displaced to the right of the spine. The esophagus and trachea are displaced to the left and are indented on the right side of the aorta. The right oblique view (Fig. 2) is the most characteristic, showing marked anterior displacement of the esophagus with indentation from behind when that structure is made visible by the use of a thick barium paste. The esophagus may be compressed and narrowed. The lower half of the cardiac shadow is of normal appearance but the upper half resembles a left oblique view which has been reversed. In the left oblique view (Fig. 3) the esophagus is not displaced to the same extent but with the aid of barium one can see it riding anterior to and above the aorta.

The condition is to be differentiated from aneurysm, bronchiogenic tumor, dermoid, abscess and other lesions casting mediastinal shadows. Theoretically there should be no difficulty in recognizing right-sided aorta, particularly if one makes out the aorta and finds that it is behind the esophagus. Once such a case has been seen, it is doubtful if the diagnosis would be missed a second time.

REPORT OF CASE

M. S., a Jewish male, aged 70, first presented himself at the Clinic in August 1926. During the first few years of his attendance he was observed several times for minor complaints, such as dental caries, a boil on the hand, an injury to the leg, "cold," constipation, backache, fracture of a finger, and contact dermatitis. In April 1939, he first complained of pain in the epigastrium. This, he stated, had been episodic for at least twenty years, but for the past two weeks had been more severe than usual. It occurred usually from twenty minutes to two hours after meals, was variable in duration, from several minutes to several hours, and was sometimes relieved by soda. It was often referred up the sternum. There was no reference of the sternal pain to the left shoulder or arm, but at times it was referred to the right lower quadrant. Pain was sometimes induced by bending forward, or was brought on by exertion, in which case it might or might not be relieved by rest. It was usually burning in character but at times was described as an ache. Other complaints were gaseous eructations, abdominal distention, and obstinate constipation. The appetite was fairly good except during exacerbations of "stomach trouble." Tarry stools had been noticed on "one or two" occasions. Various dietary régimes had been without effect on the

symptoms. Nausea and vomiting did not occur, nor had the patient noticed any particular dysphagia.

For several years the patient had experienced progressive dyspnea on exertion, relieved by rest. He had pleurisy in 1927 and "rheumatism" in 1930. He had had two attacks of hemoptysis and frequent dizzy spells, but never fell, staggered, or fainted. One brother had died of cancer and one of "heart disease." Seven children were living and well.

The patient did not appear acutely ill. He was well developed but slightly underweight. The gait was normal. No deformities or congenital defects were observed about the head or neck. The sclerae were muddy but not jaundiced, the pupils regular, equal, and of normal size, reacting promptly to light and accommodation. There was a small ulcer on the anterior portion of the right side of the nasal septum, but otherwise the ear, nose, and throat examination was not significant. There was slight cyanosis of the lips. The thyroid was normal, and there were no engorged neck veins or increased arterial pulsations. The trachea was in the mid-line, with no tracheal tug. The thorax was flat and moderately limited in expansion by senile emphysema, but bilaterally equal. There were a few fine but persistent râles at both bases. The right and left cardiac borders were within normal limits. The rhythm was regular and the rate 80. The blood pressure in each arm was 130/90. No murmurs were noted. The temporal, radial, and brachial arteries were tortuous, ribbed, and thickened. The retromanubrial dullness was not increased. There was tenderness in the right upper quadrant and epigastrium and to a less degree in both lower quadrants. There was no rigidity and no masses were made out. The liver, kidneys, spleen, and gallbladder were not palpable. The external genitalia were normal. The prostate was boggy and moderately enlarged but not nodular.

There was no significant adenopathy. A fine tremor of the extended hands was observed. The knee jerks, Achilles and plantar reflexes were normal. There was no Romberg sign. The spine was somewhat limited in movement in all directions.

Urinalyses and blood counts were normal. The blood Kahn test was negative. The icteric index was normal. The stool was negative for blood on two occasions but on the last examination, July 1941, was positive, 4+. The blood cholesterol was 145 mg. per 100 c.c. Gastric analysis showed no fasting retention, and no bile, blood, or free HCl; total acids were 12°. Four subsequent half-hourly specimens following an alcohol test meal showed 6°, 12°, 20°, 8° of free HCl and 10°, 14°, 30° total acids.

Several electrocardiograms were taken with the conventional leads and the exploring chest lead at the apex, pulmonic, and aortic areas. The rhythm was of sinus origin and the rate normal. There was slight left axis deviation. The voltage was normal in all leads. T and S-T were upright in leads 1 and 2; using the exploring chest leads with the 4R technic, the T and S-T were normal in the apical region and in the aortic area, but at the pulmonic area the T and S-T were diphasic. In this latter lead there was a Q wave 4 mm. deep and the QRS was 12 mm. in amplitude. It was considered that all leads except the last mentioned were within normal limits for a man of the patient's age and habitus, but whether the abnormalities in this lead were due to the congenital cardiac defect or evidence of myocardial degeneration we do not know. Stethograms were taken at the apex and base, with the patient lying on his right and left sides, and on bending forward. None of these maneuvers brought out any murmurs.

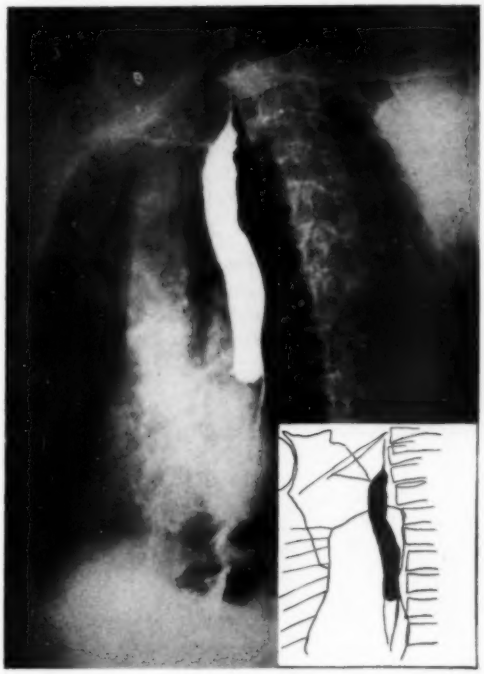

Fig. 3. Left oblique roentgenogram. The displacement of the esophagus is less evident but it can be seen anterior to and above the aorta.

Roentgen examination of the gastro-intestinal tract in August 1926 had shown evidence of a "chronic appendix." A repetition of this study in November 1927 reaffirmed this diagnosis and a gallbladder series at this time showed "failure of the gallbladder to fill." X-ray studies in May 1939 again disclosed a "chronic appendix." In December 1940 cholecystography with the double dose of dye showed a "faint filling gallbladder," with some evidence of pericholecystic adhesions. At this last examination there were also noted generalized osteoporosis and hypertrophic arthritis of the spine.

X-ray studies made on Dec. 11, 1940, showed the esophagus to be displaced to the left (Fig. 1) and anteriorly. The anterior displacement was marked in the right oblique view (Fig. 2). The arch of the aorta was seen to be behind and below the esophagus. The esophagus was displaced by an atypical aortic arch and showed a smooth compression. No tumor could be seen. The aortic arch was very prominent in the right oblique projection.

The stomach was orthotonic in type. The walls were smooth and pliable and the rugae were normal. The peristaltic waves were exaggerated. The cap appeared normal but at two hours a speck of barium was seen in the cap, which was suggestive of a niche. The stomach was completely empty. At four hours the speck was still visible in the duodenum.

The roentgen diagnosis was:

1. Right-sided aortic arch with anterior and left displacement of the esophagus.
2. Probable duodenal ulcer.
3. Hypertrophic changes of the spine.

The symptoms were evidently due to pathologic states below the diaphragm rather than above, and the anomalous condition of the aorta produced no dysphagia.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Tuberculosis as a Factor in War

In most wars prior to the twentieth century disease proved a greater factor in decimating armies than the sword. It was not, however, until the First World War that tuberculosis was revealed in its true light as a major problem both in the war and post-war period. In the United States some 300,000 World War veterans have been hospitalized for tuberculosis and it is estimated that the Veterans Administration has to date expended approximately one and a quarter billion dollars for the care of the tuberculous.

It is undoubtedly true that the earlier failure to recognize the magnitude of the problem was due largely to the lack of an accurate diagnostic procedure, such as roentgenography. In a recent article Long[1] discusses this entire subject, reviewing the experience of the First World War and the application of some of the lessons learned to the present conflict.

In 1918 the physical findings were regarded by the military authorities as superior to roentgenography in determining the presence of pulmonary tuberculosis, and in the examination of recruits reliance was placed largely on physical examination by boards of experts. Although Cole and others exerted every effort to make the roentgenogram the decisive diagnostic factor, they were unable to convince the Surgeon-General and his staff. How little was known, even in high places, of the possibilities of roentgenology is apparent from a statement which Long quotes from Col. G. E. Bushnell: "As compared with the physical examination," wrote the latter, "the roentgenological examination, even when done by an expert, occupies a place of secondary importance in the diagnosis of tuberculosis of clinical significance." Some were found, however, who regarded x-ray studies with higher favor. Among these was Lawrason Brown, whose opinion was based on experience at Plattsburg and Camp Devens.

A conflict of opinion also arose as to the disposal of latent cases. Some believed that exercise and outdoor life were so beneficial that persons with latent tuberculosis could safely stand the rigors of army life, while others contended that any man with arrested pulmonary lesions was likely to break down under the strain imposed by military conditions. It is interesting to note that no precautions were thought necessary to prevent the transmission of tuberculosis from infected to non-infected men. Little credence was placed in the possibility of exogenous infection. Only occasionally was a word of caution uttered regarding this matter.

Turning to the question of tuberculosis in connection with military service today, Long calls attention to the fact that in the interval between the First and Second World Wars the diagnosis of tuberculosis has been greatly improved. There is now no question of the superiority of roentgenography over physical examination. In May 1940, when it became apparent that defensive mobilization was unavoidable, the National Research Council, called upon for technical advice, set up among the Committees for Medical Specialties one to study the question of tuberculosis and to revise the Mobilization Regulations dealing with the examination

[1] LONG, E. R.: The War and Tuberculosis. Am. Rev. Tuberc. **45**: 616–636, June 1942.

of recruits. This Committee urged that x-ray studies of the chest be made mandatory for every candidate for induction into the military services.

Because of the lack of adequate roentgenographic equipment this recommendation could not be immediately put into effect in all induction centers. Equipment has gradually been made available, however, so that at the present time all inductees are being examined roentgenographically. For this purpose use has been made of films of standard size, sensitized paper, and miniature films. In a recent issue of RADIOLOGY (**38:** 462, April 1942) Major de Lorimier outlined in detail the factors which influenced the army in arriving at a decision to make use of stereoscopic 4 × 5 inch fluorographs.

The present standards for acceptance into military service require chest roentgenography before induction. Roentgenograms showing evidence of pulmonary tuberculosis are grounds for rejection except where the character of the lesion is such that reactivation is highly improbable. Specifically, the standards limit acceptance to those in whom evidence of disease is not more extensive than small fibroid lesions shown as sharply demarcated strand-like or well-defined nodular shadows not exceeding a total area of 5 sq. cm. on standard size chest films. Such men are deferred for subsequent roentgen observation. Calcified lesions, unless large and multiple, are not disqualifying.

From evidence which Long has been able to gather, it appears that the rejection rate because of tuberculosis in the men reaching the Induction Boards has ranged between 0.5 and 1.5 per cent. (These figures, however, do not include previous rejections by the local boards.) Since it is estimated that about 1,000,000 men were inducted into the army without x-ray examination, there must thus be from 5,000 to 15,000 tuberculous soldiers in the army at present. The importance of examining all men who have not had previous chest films, to pick up the ones with tuberculous lesions, is obvious.

An interesting aspect of Long's paper is his analysis of the effect of war on the occurrence of tuberculosis in the civilian population. During the First World War there was a sharp increase of tuberculosis among civilians, especially in the Central Powers and those countries dominated by them. Certain writers voiced the view that privation undermined the resistance and thus permitted lesions to progress to fatal forms. The recorded rate for Belgrade was 1,483 per 100,000 population in 1917. In Warsaw the rate was tripled during the German occupation. The United States also experienced a rise in the recorded tuberculosis rate in 1918. Authorities expressed varying opinions as to the effect of the influenza epidemic on the activation of old lesions. Krause is quoted by Long as regarding it likely that the excess deaths attributed to tuberculosis during October 1918 were actually due not to that disease but to influenza in tuberculous patients. Long observes, however, that as the influenza epidemic was a product of the war, the war should be charged with the deaths, whether specifically due to one disease or the other.

As to the effect of the present war on civilian tuberculosis no conclusive statement can be made, as little information is available from the Axis powers and the occupied countries. In Great Britain the reports so far show a slight general elevation of the recorded tuberculous death rate since 1939.

From a statistical study of our experience with tuberculosis during and since the First World War, it is plainly evident that we in America may look forward to an increased tuberculosis rate both in our armed forces and in our civilian population as a result of the present world conflict. It is expedient, therefore, that every effort be made to guard both the fighting man and the civilian so that the ravages of tuberculosis may be reduced to a minimum. Mass chest examination of the country's youth is the greatest public-health case-finding campaign that

has ever been attempted and should detect many early cases of tuberculosis and lead to prompt institution of proper care.

In our armed forces every effort is being made to exclude those with tuberculosis by routine roentgen examination of all recruits. A preliminary report of the practical application of this measure is presented by Bailey in this issue of RADIOLOGY (pp. 306–313). He shows that with simply installed roentgen equipment and a well-trained team examinations can be made rapidly and accurately. Among our civilian population we must keep up the fight for continued case-finding work, with insistence upon healthy living standards for the mass of our war workers and their families.

Mass Miniature Radiography of British Recruits

A recent Report of the Medical Advisory Committee on the Use of Mass Miniature Radiography in the Detection of Pulmonary Tuberculosis among Recruits for H.M. Forces[1] is of interest in view of the attention which the method has received in this country.

In the British Navy, mass miniature radiography is being carried out at the three main naval depots. This ensures examination of practically every man in the Navy at least every three years, as all men pass through one of these depots on being drafted to a fresh ship or establishment. The Navy does not examine all recruits on entry, as the number of new entry establishments is too numerous. British naval experience has shown that it is far more important to examine trained men than recruits, as the majority of symptomless carriers of tubercle bacilli are found after they have been some time in the Service rather than at the time of joining. Some 100,000 persons have been examined so far and in this group active pulmonary tuberculosis has been discovered in about 0.3 per cent. The cases examined included not only men recruited during the war but also men who had been in the Service for some years and had not, therefore, been examined by the present Civilian Medical Boards.

In the R.A.F., x-ray examination of personnel by mass miniature radiography is undertaken in the case of air-crews and of W.A.A.F. recruits who are conveniently concentrated at suitable depots. X-ray apparatus available is also being utilized at a number of Recruits' Training Centers or R.A.F. Stations where the number of persons under training or on service is large. The results of examining about 12,000 new entrants for air-crew duties show that pulmonary tuberculosis was discovered in less than 0.2 per cent. These men had been on deferred service, awaiting call, for periods up to twelve months after they had been examined by the Civilian Medical Boards.

In the Army, the use of mass miniature radiography is being developed for the examination of new recruits as apparatus becomes available. The examination of about 4,600 persons, not all of them recruited during the war, has shown an incidence of pulmonary tuberculosis of 0.1 per cent. The proportion of men discharged from the Army on account of tuberculosis during the year 1941 was 0.2 per cent.

In view of these figures the Committee regards the problem as of no great magnitude. The routine methods now practised by the Civilian Medical Boards for the detection of tuberculosis—review of information in the possession of the tuberculosis authorities, careful questioning of recruits, and reference to the Tuberculosis Officers of men with a previous history of the disease and of those in general ill health for which no specific cause can be assigned—have resulted, according to sample statistics, in the rejection of about 1 per cent of recruits on account of pulmonary tuberculosis. This percentage

[1] Printed and Published by His Majesty's Stationery Office, York House, Kingsway, London, W.C.2, 1942.

corresponds roughly with what is believed to be the incidence of the disease throughout the general population, and goes to show that the methods at present employed result in the ascertainment of a high proportion of the existing cases.

In view of this fact, and because of the decentralization of the medical examining boards, the comparatively few x-ray units of the necessary type available, and the limited number of expert examiners and specialists capable of interpreting the films, the Committee believes that for the present an attempt to apply mass miniature radiography to all recruits before entering the Forces is impracticable and that the most satisfactory alternative is to undertake radiological examination to the greatest extent possible after their entry into the Services. It is made clear that there is no doubt of the value of radiological study in the detection of incipient tuberculosis and that mass miniature radiography is the most suitable means of applying such study where there are large numbers to be examined.

Model Cancer Bill

"A State law making cancer a reportable disease is essential in order to furnish students of the cancer problem with facts which cannot be obtained from laboratory studies but can be obtained by broad studies of cancer as it occurs in the population at large." Thus summarized a special Cancer Survey Commission created by the New York State Legislature in 1939. As a result of the Commission's studies and recommendations, New York enacted in that year a law requiring physicians to report to the State Department of Health all cases of cancer coming to their attention.

Cancer is a reportable disease in 17 of the 48 states. Reports are made compulsory by regulation of the state department of health in 14 of these. In the remaining 3—New York, Wisconsin, and Rhode Island—special statutes have been enacted.

A proposal that the American College of Radiology encourage the compulsory reporting of cancer cases was submitted to the Board of Chancellors at its regular meeting in February 1942. Following thorough discussion by both proponents and opponents, the Board referred the question to a special committee for further study with instructions to submit a report at the June meeting of the Board. At that meeting the special committee, composed of Dr. Lewis G. Allen, Chairman, Dr. Arthur W. Erskine, and Dr. James J. Clark, recommended that the College sponsor a model bill making cancer a reportable disease.

In its report, the Committee expressed the opinion that organized radiology, as the group most interested in the problem of cancer, should take the lead in sponsoring sound public-health measures designed to furnish statistical information concerning cancer. A constructive effort in the interest of the public health which would stimulate lay education was both a logical and laudable project for the American College of Radiology, the Committee said. It was further pointed out that the practice of quacks, who dupe patients with false diagnoses of cancer, would be discouraged if all such cases were required by law to be reported. The Committee recommended that public-health regulations or special statutes be sponsored in the 31 states where cancer is not now reportable.

The Board of Chancellors approved the report of its special committee and instructed the Commission on Legislation to sponsor the enactment of uniform laws or regulations in all states, through the Councilors of the College. Where legislation is necessary, the committee recommends the following model bill:

"Section —. Any physician knowing that a patient treated or examined by him has cancer, carcinoma, lymphoma, sarcoma, leukemia, or any other form of malignant growth shall report the same promptly to the ——— Bureau in writing on blanks furnished by said ——— Bureau.

"The reports referred to herein shall be confidential and shall not be open to public inspection.

"All persons charged with any duty under this section who shall fail or refuse to comply with the requirements of this section shall be guilty of a misdemeanor and upon conviction thereof be fined not less than $10 nor more than $100 for each offense."

Dr. Allen's committee has pointed out that the proposed bill assures the confidential nature of the reports; information would be given to interested students and physicians according to cases, without the use of names.

The recommendations of the special committee of the College, based upon conclusions reached after an independent study, are strikingly similar to those appearing in a report prepared by the New York Cancer Survey Commission several years ago. Said that report:

"An adequate system of reporting cancer would in the course of time make available to the medical profession accurate information, instead of uncertain estimates, on (*a*) the true magnitude of the cancer problem, (*b*) the relative incidence of cancer in various sections of the state and among various

social and economic groups, (*c*) the relation between cancer and such factors as occupation, (*d*) the extent of the alleged increase in cancer above that due to ageing of the population, (*e*) the accuracy of mortality statistics, (*f*) the true incidence of the various forms of cancer. In addition there would thereby be furnished an invaluable index as to what sections of the population and what forms of cancer require the greatest attention and application of such control measures as education and the establishment of tumor clinics.

"Furthermore, it is reasonable to infer that, as in the case of other diseases which have been studied on a broad group basis, such studies, which would be greatly facilitated by statewide reporting, will discover clues to the nature of cancer which may prove of great importance in its control.

"No valid objections to making cancer a reportable disease can now be raised. The disease is fast losing, in the minds of the intelligent public, its former unmentionable character. The majority of patients with cancer at one time or another enter a hospital where the diagnosis and the identity of the patients are not concealed and, in effect, are exposed to considerably greater publicity than could possibly be attributed to confidential reports kept in the closed files of a state department of health. The fact that more than a year ago over 90 per cent of all physicians in three large metropolitan areas (Chicago, Atlanta, and New Orleans) reported by name all cases of cancer known to them during the previous year signifies the willingness of the profession to cooperate in the reporting of cancer."

Copies of the model bill have been distributed to Councilors of the College in the various states by the Commission on Legislation, with the request that they, in collaboration with the proper committee of their state medical societies, seek legislation or official regulation to make cancer a reportable disease. Sponsorship of this public health measure in a disease problem peculiarly within its special province should bring credit to all organized radiology.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

REFRESHER COURSES
POST-GRADUATE INSTRUCTION

The Executive Committee announces that the Fifth Annual Refresher Series will be presented at the time of the Twenty-eighth Annual Meeting at the Drake Hotel, Chicago, Nov. 29–Dec. 4, 1942.

The courses of post-graduate instruction will be given from 2 to 5 P.M. and 7 to 9 P.M., Sunday, Nov. 29, and from 8:30 to 10 A.M. daily thereafter during the meeting. Nothing else will be scheduled during these hours, and the courses have been so arranged that those interested in a particular subject may enroll in a related series.

The courses will be held on the mezzanine gallery of the Drake Hotel. Admission will be by ticket only. Reservations for enrollment will be made in the order in which they are received. Those who are not members of the Radiological Society of North America will be charged a fee of Two Dollars ($2.00) for a single course or a maximum charge of Five Dollars ($5.00) for the series.

Read the description of the courses, noting particularly the days upon which they are offered; study the Plan of Presentation and select carefully your choice for each day, as the number attending each course will be limited. If the directions listed on the Plan of Presentation are followed carefully, errors in enrollment will be avoided.

If the Refresher Courses are not filled by the time of the meeting, tickets will be available at the registration desk on Sunday, Nov. 29, and thereafter.

In the present national emergency it may be necessary to revise our Plan of Presentation and make occasional changes in instructors, as some may be called into military service prior to the Annual Meeting. We will adhere as closely as possible, however, to your choice of the Refresher Courses.

Course No. 1: Sunday, 2–5 P.M.

F. H. SQUIRE, M.D., JAMES B. EYERLY, M.D., CARL W. APFELBACH, M.D., EDWIN MILLER, M.D., and JOHN M. DORSEY, M.D.

Staff of Presbyterian Hospital, University of Illinois (Rush) Medical School, Chicago, Illinois

(By Invitation)

Diseases of the Esophagus, Stomach, and Duodenum

JAMES B. EYERLY, M.D.

1. Medical aspects of diseases of the esophagus, stomach, and duodenum.
   - (*a*) Physiology.
   - (*b*) Types of diseases.
   - (*c*) Treatment.

F. H. SQUIRE, M.D.

2. Radiological examination of stomach and duodenum demonstrating pathological changes.

CARL W. APFELBACH, M.D.

3. Pathological anatomy of esophagus, stomach and duodenum.

JOHN M. DORSEY, M.D.

4. Surgery of the esophagus.
   - (*a*) Anatomy.
   - (*b*) Surgical diseases.
     - Congenital abnormalities.
     - Infections.
     - Tumors.

EDWIN MILLER, M.D.

5. Surgery of stomach and duodenum.
   - (*a*) Anatomy of stomach and duodenum.
   - (*b*) Surgery of gastric and duodenal ulcer and carcinoma.
   - (*c*) Congenital obstruction of duodenum.
   - (*d*) Chronic duodenal ileus.

Course No. 2: Sunday, 2–5 P.M.

OTTO GLASSER, Ph.D., ROBERT TAFT, M.D., and ROBERT S. LANDAUER, Ph.D.

OTTO GLASSER, Ph.D., Cleveland Clinic, Cleveland, Ohio

1. History of radiology and atomic physics.

ROBERT TAFT, M.D., Charleston, South Carolina

2. Testing of radiographic materials.

The radiologist in charge of a perfectly functioning department is quite justified in the assumption that he need know very little about the tools with which he works, as he has at his elbow a skilled physicist and competent technicians and is within easy reach of service men. In the present emergency, however, he may find himself in a situation where no such resources are available and may be totally dependent on his own efforts to diagnose troubles and correct them. Some knowledge of the methods of testing materials may be of great value. The purpose of this course is to give brief and specific directions for determining faults. In general, difficulties may be classed as (1) electrical, (2) mechanical, and (3) photographic. Time permitting, all the common tests will be outlined.

ROBERT S. LANDAUER, Ph.D., Highland Park, Illinois

3. Physics question box.

If you have any question on the subject of x-ray physics which is puzzling you (and who hasn't?)

send it in. We will find an answer for it and discuss it with you at the *Question Box* session. Since this session will be definitely "rehearsed," your questions must be in by the early part of November. Send questions to Robert S. Landauer, Ph.D., 1317 Judson Ave., Highland Park, Ill. One Thoraeus filter will be given absolutely free for the best question sent in. All questions become the property of the Physics Question Box and the decision of the judge (myself) will be final.

Course No. 3: Sunday, 2–5 P.M.

Radiation Therapy: Panel Discussion

EDWARD L. JENKINSON, M.D.
Chicago, Illinois
Presiding

Carcinoma of Breast:

U. V. PORTMANN, M.D., Radiologist, Cleveland, Ohio
W. R. CUBBINS, M.D., Professor of Surgery, Loyola University School of Medicine, Chicago (by invitation)
W. C. MacCARTY, M.D., Professor of Pathology, University of Minnesota Graduate Medical School, Rochester, Minnesota (by invitation)
B. H. ORNDOFF, M.D., Radiologist, Chicago, Illinois

Carcinoma of Skin:

EDWARD A. OLIVER, M.D., Assoc. Clin. Professor of Dermatology (Rush), University of Illinois, Chicago (by invitation)
(Additional instructors to be announced)

Each participant in this course will make a preliminary presentation of the subject under discussion. The Chairman of the Panel will propound questions for the various participants, who will answer and discuss them in some detail.

Carcinoma is undoubtedly one of the most serious conditions with which the surgeon and radiologist have to contend, and any information gleaned from a panel discussion of this type is of great value to the profession. The membership may feel free to send in questions to the Chairman, preferably before the panel begins, and the participants will make an effort to answer or at least discuss the questions. The three-hour period will be equally divided between presentation of the problems of treatment of Carcinoma of the Breast and Carcinoma of the Skin.

Course No. 4: Sunday, 7–9 P.M.

Roentgenologic Diagnosis of Neurological Lesions: Panel Discussion

ADOLPH HARTUNG, M.D., Presiding
Staff of the University of Illinois, College of Medicine
(By Invitation)

ERIC OLDBERG, M.D., Professor of Neurology and Neurological Surgery
PERCIVAL BAILEY, M.D., Professor of Neurology and Neurological Surgery
PAUL C. BUCY, M.D., Professor of Neurology and Neurological Surgery
A. S. J. PETERSON, M.D., Associate in Radiology
T. J. WACHOWSKI, M.D., Asst. Professor in Radiology

Brief historical review of the roentgenological methods used in neurological diagnosis. Technical procedures with and without contrast media. Interpretation of negatives with correlation of the clinical and pathological findings. Specific information in response to requests from the audience.

Course No. 5: Sunday, 7–9 P.M.

W. EDWARD CHAMBERLAIN, M.D.
Philadelphia, Pennsylvania
Presiding

L. H. GARLAND, M.D., San Francisco, California
FRED J. HODGES, M.D., Ann Arbor, Michigan
EARL E. BARTH, M.D., Chicago, Illinois

Film-Reading Session

Those attending the course are invited to bring reports and roentgenograms of interest or difficult cases for presentation and informal discussion. Only those cases in which the diagnosis is proved or in which evidence is conclusive should be submitted. Those conducting the conference will depend upon voluntary submission of material by those enrolled.

Course No. 6: Sunday, 7–9 P.M.

Radiation Therapy: Panel Discussion

JAMES T. CASE, M.D.

Professor of Radiology, Northwestern University Medical School, Chicago, Illinois
Presiding

Intra-Oral Lesions:

V. P. BLAIR, M.D., Professor of Clinical Surgery, Washington University School of Medicine, St. Louis, Missouri (by invitation)
THOMAS C. GALLOWAY, M.D., Asst. Professor of Oto-Laryngology, Northwestern University Medical School, Chicago, Illinois (by invitation)
DOUGLAS QUICK, M.D., Radiologist, New York

Pelvic Cancer:

JAMES P. SIMONDS, M.D., Professor of Pathology, Northwestern University Medical School, Chicago, Illinois (by invitation)
GEORGE KAMPERMAN, M.D., Gynecologist, Detroit, Michigan (by invitation)
GEORGE GARDNER, M.D., Asst. Professor of Gynecology, Northwestern University Medical School, Chicago, Illinois (by invitation)
H. DABNEY KERR, M.D., Professor of Radiology, State University of Iowa, College of Medicine, Iowa City, Iowa
EDWIN C. ERNST, M.D., Radiologist, St. Louis, Missouri

Each participant in this course will make a brief presentation of his subject followed by questions

propounded by the Chairman, in an attempt to bring out practical points from the surgical, pathological, and radiological aspects. The Chairman will welcome questions from the audience, which will be answered by the various members on the Panel, including our distinguished guests. Those registered in this course are urged to come prepared to take part in the discussion.

Course No. 7: Monday, 8:30–10 A.M.

B. R. KIRKLIN, M.D.

Rochester, Minnesota

Gallbladder and Pancreas

1. Cholecystography by the oral method will be described and discussed. Emphasis will be laid on the necessity of employing meticulous care in administering the dye, in executing the roentgenographic technic, and in interpreting the cholecystographic response. Criteria of distinction between normal and abnormal response will be presented, and illustrative cholecystograms will be shown.
2. (*a*) Disclosure of tumors of the pancreas with the aid of opaque ingesta.
   (*b*) Roentgenographic demonstration of pancreatic calculi.

Course No. 8: Monday, 8:30–10 A.M.

LEO G. RIGLER, M.D.

Professor of Radiology
University of Minnesota

Acute Pulmonary Conditions

The acute pulmonary conditions to be discussed will include: (1) pulmonary congestion, (2) pulmonary edema, (3) pulmonary infarct, (4) pneumonias of various types, (5) acute massive atelectasis.

Detailed studies will be presented to bring out: (1) the pathological physiology as manifested in the roentgen examination; (2) the roentgen findings in the incipiency and in the later stages; (3) the roentgen findings as compared to the gross pathology; (4) the differential diagnostic features; (5) the validity of the roentgen findings in relation to the time of onset, the symptomatology, the first appearance of physical signs, and eventual course of the disease.

Course No. 9: Monday, 8:30–10 A.M.

ROBERT A. ARENS, M.D.

Director, Roentgen Department, Michael Reese Hospital
Chicago, Illinois
and
(By Invitation)
IRVING F. STEIN, M.D.

Associate Professor, Obstetrics and Gynecology
Northwestern University Medical School
Chicago, Illinois

Gynecography: Pneumoperitoneum and Hystero-Salpingography

The presentation will consist of a round-table discussion including the history, armamentarium required, and technic for complete gynecography including transuterine and transabdominal methods, pneumoperitoneum, and hystero-salpingography, alone and combined. The radiological procedure, including the exposure, distance, posture, etc., will also be shown. Consideration will also be given to the diagnostic value of the method, its therapeutic application in tuberculous peritonitis and salpingitis, and also the value of transuterine insufflation in sterility. The teaching value of the method to students will be stressed. Lantern demonstration.

Course No. 10: Monday, 8:30–10 A.M.

PAUL C. HODGES, M.D.

Professor of Roentgenology
The University of Chicago
and
(By Invitation)
DALLAS B. PHEMISTER, M.D.

Professor of Surgery
The University of Chicago

Aseptic Necrosis of Bone

The x-ray findings are well established in certain of the aseptic necroses, such as Perthes' disease and Osgood-Schlatter's disease in children and osteochondritis dissecans in adults, though the underlying causes are as yet not well understood. Similar necrosis resulting from the over-irradiation of bone is now generally recognized. Less well known are lesions of this sort resulting from the cutting off of the blood supply by injuries such as fractures and dislocations, by caisson disease, and by thrombosis, embolism, and obliterative endarteritis.

The bone infarcts that follow the cutting off of local blood supply do not become separated as sequestra but instead are gradually invaded and replaced by blood vessels, fibrous tissue, and osteogenic tissue. This replacement is a slow, chronic process but eventually it may be complete, particularly in small lesions and in children. Sometimes, however, replacement may be incomplete and small or even large areas of infarction may become calcified and persist for the remainder of life.

In the earlier stages of the disease, areas of necrotic bone are detectable in roentgenograms because they retain their normal density whereas the surrounding living bone becomes translucent through disuse. Later if the infarcts become calcified they stand out sharply against the background and there are usually dense lines demarcating them from the surrounding tissue.

Lantern slides will be used to demonstrate the radiology and pathology of these conditions.

Plan of Presentation

SUNDAY 2–5 P.M.	MONDAY 8.30–10 A.M.	TUESDAY 8.30–10 A.M.
1. **Diseases of the Esophagus, Stomach, and Duodenum** F. H. Squire, M.D. James B. Eyerly, M.D. Carl W. Apfelbach, M.D. Edwin Miller, M.D. John M. Dorsey, M.D.	7. **Gallbladder and Pancreas** B. R. Kirklin, M.D.	13. **Technic of Diagnosis of Duodenal Lesions by the Mucosal Relief Method** F. E. Templeton, M.D.
2. 1. **History of Radiology and Atomic Physics** Otto Glasser, Ph.D. 2. **Testing of Radiographic Materials** Robert Taft, M.D. 3. **Physics Question Box** Robert S. Landauer, Ph.D.	8. **Roentgen Manifestations of Acute Pulmonary Conditions** Leo G. Rigler, M.D.	14. **Virus Pneumonia** Howard P. Doub, M.D.
3. **Radiation Therapy: Panel Discussion** Edward L. Jenkinson, M.D., Presiding **Carcinoma of Breast** U. V. Portmann, M.D. W. C. MacCarty, M.D. W. R. Cubbins, M.D. B. H. Orndoff, M.D. **Carcinoma of Skin** Edward A. Oliver, M.D. (Additional instructors to be announced)	9. **Gynecography: Pneumoperitoneum and Hystero-Salpingography** Robert A. Arens, M.D. Irving F. Stein, M.D.	15. **Cardiovascular Roentgenology** Earl E. Barth, M.D.
7–9 P.M.	10. **Aseptic Necrosis of Bone** Paul C. Hodges, M.D. Dallas B. Phemister, M.D.	16. **Differential Diagnosis of Bone Tumors** B. H. Nichols, M.D.
4. **Roentgenologic Diagnosis of Neurological Lesions: Panel Discussion** Adolph Hartung, M.D., Presiding Eric Oldberg, M.D. Percival Bailey, M.D. Paul C. Bucy, M.D. A. S. J. Peterson, M.D. T. J. Wachowski, M.D.		
5. **Film-Reading Session** W. Edward Chamberlain, M.D., Presiding L. H. Garland, M.D. Fred J. Hodges, M.D. Earl E. Barth, M.D.	11. **Fundamental Principles of Protacted Fractional Radiation** H. Dabney Kerr, M.D.	17. **Radiation Therapy of the Breast** Lewis G. Allen, M.D.
6. **Radiation Therapy: Panel Discussion** James T. Case, M.D., Presiding **Intra-Oral Lesions** V. P. Blair, M.D. T. C. Galloway, M.D. Douglas Quick, M.D. **Pelvic Cancer** J. P. Simonds, M.D. George Gardner, M.D. George Kamperman, M.D. H. Dabney Kerr, M.D. Edwin C. Ernst. M.D.	12. **Characteristics of X-rays** J. L. Weatherwax, M.A.	18. **Measurement, Calculation, and Recording of X-ray Dosage** Edith H. Quimby, Sc.D.

Plan of Presentation

WEDNESDAY 8.30–10 A.M.	THURSDAY 8.30–10 A.M.	FRIDAY 8.30–10 A.M.
19. **Gastro-Intestinal Tract in Infants and Young Children** William E. Anspach, M.D.	25. **Radiology of the Small Intestine** Kenneth S. Davis, M.D.	30. **Roentgen Differentiation of Abdominal Tumors** Samuel Brown, M.D.
20. **The Diseases of the Lesser Circulation** W. Walter Wasson, M.D.	26. **Diseases of the Mediastinum and Associated Conditions** Lester W. Paul, M.D.	31. **Pulmonary Tuberculosis** C. C. Birkelo, M.D.
21. **The Intervertebral Disc** Joseph C. Bell, Major, M.C.	27. **X-ray Findings in Low Back Pain** Hollis E. Potter, M.D.	32. **Roentgenologic Diagnosis of Intracranial Disease** John D. Camp, M.D.
22. **Radiological Aspects of the Arthritides** L. H. Garland, M.D.	28. **Roentgenology of the Urinary Tract** Eugene P. Pendergrass, M.D. George W. Chamberlin, M.D., B.S., Sc.D. (Med.) P. Boland Hughes, A.B., M.D.	33. **Roentgenology of the Urinary Tract** Eugene P. Pendergrass, M.D. George W. Chamberlin, M.D., B.S., Sc.D. (Med.) P. Boland Hughes, A.B., M.D.
23. **Radiation Treatment of Carcinoma of the Cervix** A. N. Arneson, M.D.	29. **Irradiation Therapy of Carcinoma of the Uterine Fundus** Robert E. Fricke, M.D.	34. **Treatment of Endocrine Dysfunction with Roentgen Rays** Milton Friedman, Major, M.C.
24. **Outline of Nuclear Physics** K. W. Stenstrom, Ph.D. **Biological Applications of Nuclear Physics** Gioacchino Failla, D.Sc.		

Course No. 11: Monday, 8:30–10 A.M.

H. DABNEY KERR, M.D.

The State University of Iowa, Department of Radiology
Iowa City, Iowa

Fundamental Principles of Protracted Fractional Radiation

This course is prepared primarily for those wishing to review in some detail the factors concerned in the irradiation treatment of malignant tumors in the pelvis. Stress will be laid on physics in relation to x-ray production, scatter, filter, depth dose per cent, field size and field number, calculation of tumor dose especially to the parametrium, reactions, complications, and results. This is essentially an outline of the treatment as used in our hospital.

Course No. 12: Monday, 8:30–10 A.M.

J. L. WEATHERWAX, M.A.

Philadelphia General Hospital
Philadelphia, Pennsylvania

Characteristics of X-Rays

The fundamental characteristics of x-rays, including the following subjects: production of x-rays; x-ray spectrum; absorption of x-rays; factors controlling the quality and quantity; measurement of quality and quantity. In general, the outline published in RADIOLOGY **31:** 464–472, October 1938, covers the material to be given. A reprint of the outline will be given to those taking the course. Time will be allowed for questions.

Course No. 13: Tuesday, 8:30–10 A.M.

F. E. TEMPLETON, M.D.

Associate Professor of Roentgenology
University of Chicago
Chicago, Illinois

Technic of Diagnosis of Duodenal Lesions by the Mucosal Relief Method

The conditions influencing the demonstration of a mucosal surface, the equipment and the technic used in examining the stomach and duodenum are discussed. The factors influencing the demonstration of mucosal surfaces are outlined as follows:

A. Physical Factors.
   1. The state of the medium.
   2. The condition of the mucosa.
   3. The contents of the lumen.
   4. The build of the patient.

B. Anatomical Factors.
   1. Demonstration of single surfaces.
   2. Demonstration of superimposed surfaces.
   3. Clinical application.
      (*a*) Under normal conditions.
      (*b*) Under pathological conditions.

C. Physiological Factors.
   1. Passive factors.
      (*a*) Respiration.
      (*b*) Position of the patient.
      (*c*) Transmitted pulsation.
      (*d*) Pressure.
         (1) Extrinsic.
         (2) Intrinsic.
      (*e*) Muscular.
         (1) Tonus.
         (2) Peristalsis.
   2. Active factors.
      (*a*) Autonomic theory of Forssell.

After briefly discussing the filming fluoroscope or "spot" machine, the technic of examination will be discussed in detail as follows:

A. Preparation of the patient.
B. The media.
C. Planning the examination.
D. Actual roentgenologic examination.
   1. A routine method.
      (*a*) Fluoroscopy.
   2. Procedures for special situations.
      (*a*) Diaphragmatic hernia with a brief discussion of the phrenic ampulla.
      (*b*) Cascade stomach.
      (*c*) Pyloric obstruction.
      (*d*) High posterior bulb, and antrum.
      (*e*) Air in the duodenal bulb.
      (*f*) Patients too ill to stand.
      (*g*) Infants.
   3. Indications for exposing of the films.
      (*a*) The "spot" film.
      (*b*) The "survey" film.
   4. Application of pressure.

Course No. 14: Tuesday, 8:30–10 A.M.

HOWARD P. DOUB, M.D.

Department of Roentgenology
Henry Ford Hospital
Detroit, Michigan

Virus Pneumonia

The purpose of this discussion will be to point out the clinical and roentgenological aspects of the atypical pneumonia known as virus pneumonia. Its differentiation from other lung diseases will be discussed. A lantern slide demonstration will illustrate the roentgen changes in this and other pulmonary lesions.

Course No. 15: Tuesday, 8:30–10 A.M.

EARL E. BARTH, M.D.

Northwestern University Medical School
Chicago, Illinois

Cardiovascular Roentgenology

This course will consist of a film and lantern slide demonstration of the roentgenographic signs of

cardiac aneurysm, constrictive pericarditis, congenital heart disease and intracardiac calcification, as well as the common diseases of the heart. The anatomy of the heart and of the great vessels and their relationship to surrounding structures will be reviewed with a model as a guide. Brief mention will be made of the use of the roentgen kymogram in diseases of the heart. If there is sufficient time, the more common diseases of the aorta will be covered.

Course No. 16: Tuesday, 8:30–10 A.M.

B. H. NICHOLS, M.D.

Cleveland Clinic, Cleveland, Ohio

Differential Diagnosis of Bone Tumors

This course will consist of a classification of bone tumors with a description of the characteristics of each type as observed from the roentgenologic and clinical standpoint. The various types of tumors will be arranged in groups with their special characteristics, such as the point of origin, osteolytic character or sclerosing tendency, and whether or not they invade the surrounding tissue. In this primary survey, the differential diagnosis will be considered, and illustrated, between bone tumors and infections of bone, both the specific types, such as tuberculosis and syphilis, and osteomyelitis in general. Consideration will be given traumatic lesions of bone which may simulate a tumor; also bone changes due to systemic disease and lesions of bone of unknown etiology.

By careful analysis and a process of elimination, a given case may be brought to a question of three or four types of tumor. When this stage in the examination is reached, a consideration is undertaken of the clinical history, the physical examination, the laboratory findings, and the probabilities in each of the suspected tumors. In applying this law of probability, there are about twenty-five points of importance for consideration, as, for example, the age of the patient, the duration of the disease, the presence or absence of pain, and the location of the lesion. After this group of probabilities has been completely canvassed, a summation will show the greatest number of these probabilities belonging to one of the suspected tumors. This, then, will most likely be the correct diagnosis.

Course No. 17: Tuesday, 8:30–10 A.M.

LEWIS G. ALLEN, M.D.

Kansas City Kansas

Radiation Therapy of the Breast

This course will consist of a review of the present status of our knowledge of the problems of breast cancer as clinically presented. The pathologic classifications and the clinical factors which modify them will be presented and discussed.

The theoretical origin and spread of cancer of the breast will be discussed in detail. The prognostic significance of age, pregnancy, lactation, menstruation, and disease will be considered.

The value of irradiation will be shown by analysis of case reports taken from recent literature. The plan of radiation management will be discussed and technics summarized. A definition of preoperative and postoperative combinations will be offered. Radium therapy by surface, interstitial, and pack applications will be discussed briefly. Radiation therapy as an independent form of treatment will be evaluated. Complications and sequelae of radiation therapy will be defined. Finally, a procedure for application of roentgen irradiation, such as the mapping of ports, the choice of technic of application, dosage computation and spacing, in illustrative clinical stages of cancer of the breast, will be offered.

Course No. 18: Tuesday, 8:30–10 A.M.

EDITH H. QUIMBY, Sc.D.

Memorial Hospital, New York City

Measurement, Calculation, and Recording of X-ray Dosage

Ionization in air and its application to x-ray measurements.

Measurement of quality: absorption curve, half-value layer.

Measurement of quantity: the roentgen.

Essential aspects of dosage: relation between air and tissue dose.

Effects of physical factors on quality and quantity of radiation—voltage, filter, distance, etc.

The calculation of tissue dose.

(*a*) After irradiation, from measured air or skin dose.

(*b*) The predetermined tissue dose, with calculation of the necessary air or skin dose.

The time factor.

Errors in dosage due to errors in physical factors.

Dosage records.

(An outline will be furnished.)

Course No. 19: Wednesday, 8:30–10 A.M.

WILLIAM E. ANSPACH, M.D.

Chicago, Illinois

Gastro-Intestinal Tract in Infants and Young Children

This course will consist of a survey of lesions of the gastro-intestinal tract as observed in a children's hospital. It will include a slide demonstration of common and rare anomalies and acquired diseases. A portion of the period will be devoted to roentgen manifestations of complications of lesions in and along the alimentary canal.

Course No. 20: Wednesday, 8:30–10 A.M.

W. WALTER WASSON, M.D.

Denver, Colorado

The Diseases of the Lesser Circulation

This course will be an attempt to discuss the dynamics of the lesser circulation with a detailed presentation of the anatomy and the physiology. Every day the roentgenologist is endeavoring to evaluate in terms of pathology the air content of the lungs and the dynamics of the chest as a whole, and particularly of the lesser circulation. It is hoped that a few additional facts may be added to the present common knowledge in regard to the lesser circulation. There will be a brief presentation of the clinical diseases of the lesser circulation.

Course No. 21: Wednesday 8:30–10 A.M.

JOSEPH C. BELL, Major, M.C.

Percy Jones Hospital, Battle Creek, Michigan

The Intervertebral Disc

The anatomy of the intervertebral disc will be discussed, together with its nerve supply and some of the abnormalities of this structure.

The roentgen findings in the presence of herniation of a portion of the disc into the spinal canal with resultant compression of the adjacent nerve root or roots will be considered, together with operative findings and postoperative results.

The various media in common use for contrast myelography will be reviewed, special emphasis being given to Pantopaque, the newest medium for contrast myelography. The technic of injection, roentgenoscopy, roentgenography, and removal of the medium will receive detailed consideration.

All phases of the presentation will be fully illustrated by lantern slides.

Course No. 22: Wednesday, 8:30–10 A.M.

L. H. GARLAND, M.D.

San Francisco, California

Radiological Aspects of the Arthritides

Following a definition of the term "arthritis," there will be presented a general classification of the arthritides and allied arthropathies. The pathological appearance of the more important forms of arthritis will be discussed. Diagnosis and differential diagnosis of the various types of arthritis will then be outlined, illustrated with roentgenograms, and presented for brief debate. The lack of correlation between the clinical symptoms and roentgenologic findings in common forms of so-called arthritis will be outlined and an attempt will be made to evaluate the usefulness of roentgen examination in the early diagnosis of certain forms of infectious arthritis. The technic and results of the newer forms of roentgen examination of the joints by the use of intra- and extra-articular opaque media and mechanical traction will be considered. If time permits, the value and results of roentgen treatment of a few certain specific types of arthritis will be presented and illustrated by lantern slides.

Course No. 23: Wednesday, 8:30–10 A.M.

A. N. ARNESON, M.D.

St. Louis, Missouri

Radiation Treatment of Carcinoma of the Cervix

This course is intended to present a review of factors believed to affect the treatment of cervical cancer. Radiosensitivity will be considered, and an attempt will be made to correlate the gross appearance of lesions with the response to be expected. The importance of infection will be discussed, as well as methods for decreasing inflammation.

Technics for applying 200 kv. x-rays externally as well as intravaginally will be described. Radium treatment will be discussed with special emphasis upon the dose delivered by each source. No attempt will be made to compare end-results, since the points in question apply chiefly to the immediate effect of treatment.

Course No. 24: Wednesday, 8:30–10 A.M.

K. W. STENSTROM, Ph.D., and GIOACCHINO FAILLA, D.Sc.

Nuclear Physics

K. W. STENSTROM, Ph.D., University of Minnesota Medical School, Minneapolis, Minn.

1. Outline of nuclear physics.
   - (*a*) Atomic structure according to the Rutherford-Bohr theory.
   - (*b*) Fundamental units: electron, proton, neutron, positron, mesotron, neutrino.
   - (*c*) Combination of fundamental units in the atomic nuclei.
   - (*d*) Heavy hydrogen (deuterium) and consideration of isotopes in general.
   - (*e*) Natural radioactivity and the radioactive series, alpha, beta, and gamma radiation.
   - (*f*) Disintegration of nuclei by alpha particle bombardment.
   - (*g*) Radioactive isotopes produced by alpha particle bombardment.
   - (*h*) Other particles used to cause nuclear reactions.
   - (*i*) Some examples of nuclear reactions and of induced radioactivity.

GIOACCHINO FAILLA, D.Sc., Memorial Hospital, New York

2. Biological applications of nuclear physics.
   Recent developments in nuclear physics provide

sources of ionizing radiations having special characteristics which greatly enlarge the fields of radiobiology and radiotherapy.

The most significant results obtained thus far will be reviewed and probable future extensions will be discussed in each of the following fields:

(*a*) Use of radioactive isotopes in the study of biological phenomena.

(*b*) Use of radioactive isotopes in the treatment of neoplastic diseases.

(*c*) Use of neutrons in cancer therapy.

Certain inherent limiting factors of the old and new therapeutic agents will be brought out in the discussion.

Course No. 25: Thursday, 8:30–10 A.M.

KENNETH S. DAVIS, M.D.

Los Angeles, California

Radiology of the Small Intestine

This course is planned to cover the roentgen anatomy of the small intestine, together with the changes produced by various pathologic conditions.

Method of examination, the normal small intestine, disturbances in physiology, inflammations, and neoplasms will be discussed.

Course No. 26: Thursday, 8:30–10 A.M.

LESTER W. PAUL, M.D.

Department of Radiology, University of Wisconsin
Madison, Wisconsin

Diseases of the Mediastinum and Associated Conditions

In this discussion will be included those lesions which produce mass shadows of abnormal character within and adjacent to the mediastinum. The anatomy of the mediastinum and of the tracheobronchial lymph node system will be reviewed, followed by a discussion of the roentgen anatomy of these parts. The roentgen aspects of the diseases affecting the mediastinal and tracheobronchial lymph nodes will be presented in some detail, including acute and chronic non-specific infections, fungous infections, primary tuberculosis, and hyperplastic tuberculous adenitis in adults. In this latter connection the lymph node changes seen in erythema nodosum will be discussed. Also reference will be made to sarcoid disease and an attempt will be made to correlate these conditions as far as present knowledge permits. The various primary and secondary tumors involving the lymph nodes will be covered, particularly Hodgkin's disease, lymphosarcoma, and metastases from primary tumors elsewhere.

Illustrative cases will be used in which serial roentgenograms show the appearance of the chest before the development of the disease, its course, and in some instances a return to normal. Emphasis will be placed on the recognition of early change as shown by the serial roentgenograms. Other diseases that may produce abnormal shadows in the mediastinum will be discussed, including lesions of the spine, pulmonary artery, aorta, esophagus, acute and chronic mediastinitis, intrathoracic thyroid, enlargement of the thymus, and certain forms of carcinoma of the bronchial tree. Cardiac lesions will not be included except as they must be differentiated from extracardiac abnormalities.

Course No. 27: Thursday, 8:30–10 A.M.

HOLLIS E. POTTER, M.D.

Chicago, Illinois

X-ray Findings in Low Back Pain

A review of both the more common and the rarer x-ray findings in low back pain which must be considered in the clinical diagnosis, the prognosis, and the treatment. Differentiation between vertebral injury and vertebral disease, congenital or acquired.

Courses Nos. 28 and 33: Thursday and Friday, 8:30–10 A.M.

EUGENE P. PENDERGRASS, M.D., GEORGE W. CHAMBERLIN, M.D., B.S., ScD. (Med.), and P. BOLAND HUGHES, A.B., M.D. (by invitation)

University of Pennsylvania

Roentgenology of the Urinary Tract

(Course requires two days: the first three items being considered on the first day and the second three on the second day.)

1. Roentgen methods and materials.
   - (*a*) Evaluation of types of examination.
   - (*b*) Uses and limitation of roentgen procedures.
   - (*c*) Dangers of urography.
2. The normal urinary tract.
   - (*a*) Physiology.
   - (*b*) Anatomy.
   - (*c*) Roentgen interpretation.
3. Anomalies and variants.
   - (*a*) Embryology of some of the common anomalies.
   - (*b*) Role of anomalies in development of disease.
   - (*c*) Late results of anomalies.
4. Roentgen interpretation of genito-urinary tract disease.
   - (*a*) Stones.
   - (*b*) Infections.
   - (*c*) Tumors.
   - (*d*) Cysts.
   - (*e*) Miscellaneous.
5. Value of urography in disease primarily outside of the urinary tract.
   - (*a*) Aneurysms.
   - (*b*) Retroperitoneal tumors and infections.
6. Cystoscopy and urethrography.

Course No. 29: Thursday, 8:30–10 A.M.

ROBERT E. FRICKE, M.D.

Section of Therapeutic Radiology
Mayo Clinic, Rochester, Minnesota

Irradiation Therapy of Carcinoma of the Uterine Fundus

Irradiation treatment of carcinoma of the uterine fundus is an interesting problem and one which is increasing in scope and importance. Planning of treatment depends on the recognition of three categories, as follows: (1) preoperative or postoperative irradiation; this type of irradiation is employed when the attack is to be or has been mainly surgical, the patients are in good general physical condition, and the lesions are recognized before much extension has occurred; (2) limited irradiation for extensive inoperable carcinoma with palliation in view; five-year cures are occasionally obtained even in this group; (3) complete irradiation therapy for less extensive tumors in patients who are advanced in age or have serious co-existing disease which makes surgical intervention hazardous.

The technic of treatment will be considered with regard to these three classifications. The symptomatology, diagnosis, complications, and the significance of the microscopic grade and of the stage or extent of the lesion will be discussed. The immediate and final results of irradiation therapy alone will be summarized in a review of cases treated over an eleven-year period at the Mayo Clinic.

Course No. 30: Friday, 8:30–10 A.M.

SAMUEL BROWN, M.D.

Cincinnati, Ohio

Roentgen Differentiation of Abdominal Tumors

This course will cover the roentgen diagnosis of extra-gastro-intestinal tumors by an indirect method of approach which consists in the study of the stomach and bowels in their relation to the neighboring organs. It has been found that, in the presence of a tumor arising from any of the adjacent organs, characteristic changes take place in the relation, position, and contour of the hollow viscera according to the position of the body as a whole. With these facts at our disposal, it has been possible to diagnose the presence, location, and origin of many a tumor in the abdomen.

Course No. 31: Friday, 8:30–10 A.M.

C. C. BIRKELO, M.D.

Radiologist, Herman Kiefer Hospital and Maybury Sanatorium
Detroit, Michigan

Pulmonary Tuberculosis

This presentation will consist of a lantern slide demonstration of both the common and unusual forms of pulmonary tuberculosis. The primary tuberculous infection, as it occurs in the child and young adult, will be demonstrated. Reinfection tuberculosis of both the productive and exudative types will be shown and the commonly accepted methods of treatment will be briefly discussed.

Differential diagnosis will include x-ray demonstration of cases which resemble tuberculosis but have been found to be bronchopneumonia, primary and metastatic tumors of the lungs, bronchiectasis and cystic disease, lung abscess, mitral heart disease, and silicosis. All material presented will consist of proved cases.

Course No. 32: Tuesday, 8:30–10 A.M.

JOHN D. CAMP, M.D.

Section on Roentgenology, Mayo Clinic
Rochester, Minnesota

Roentgenologic Diagnosis of Intracranial Disease

The evidence of intracranial disease that is revealed in roentgenograms without the use of additional procedures such as encephalography and ventriculography will be discussed.

1. Various forms of calcification occurring in intracranial lesions.
2. Changes in the calvarium.
   (*a*) Generalized changes due to abnormalities of development as a result of intracranial pathology.
   (*b*) Changes resulting from increased pressure.
   (*c*) Localized changes in the calvarium contiguous to the site of lesions, such as destruction, proliferation, or both.
3. Changes in the sella turcica.
4. Pineal calcification and displacement of the pineal shadow.
5. Vascular changes in the calvarium.

It will be emphasized in this course that the position of many intracranial lesions may be determined by careful examination of plain roentgenograms without the use of additional diagnostic procedures. Tumors of the scalp and skull simulating intracranial disease will also be discussed.

Course No. 33: Friday, 8:30–10 A.M.

EUGENE P. PENDERGRASS, M.D., GEORGE W. CHAMBERLIN, M.D., B.S., Sc.D. (Med.), and P. BOLAND HUGHES, A.B., M.D. (by invitation)

University of Pennsylvania
Philadelphia, Pennsylvania

Roentgenology of the Urinary Tract

For description see Courses Nos. 28 and 33, page 355.

Course No. 34: Friday, 8:30–10 A.M.

MILTON FRIEDMAN, Major, M.C.

Treatment of Endocrine Dysfunction with Roentgen Rays

1. Brief review of the endocrine imbalances, which are to be treated with roentgen rays.
2. Dysfunctions due to failing ovarian function:
   (*a*) Puberty menorrhagia, a manifestation of mild ovarian deficiency which can often be corrected with small-dose "stimulation" roentgen therapy of the pituitary gland, alone or in conjunction with ovarian irradiation.
   (*b*) Maturity menorrhagia, a complex dysfunction due to many causes, wherein radiotherapy is seldom indicated.
   (*c*) Premenopausal menorrhagia: mechanism of the imbalance; influence of various factors on the castration dose.
   (*d*) Sterility, accompanied by menometrorrhagia or secondary amenorrhea (mild ovarian dysfunction), or amenorrhea (severe ovarian dysfunction). Treatment with "small-dose" x-ray therapy.
      (1) Possible genetic damage following irradiation of the ovary.
3. Pituitary dysfunctions.
   (*a*) Primary hyperplasia or neoplasia: acromegaly, basophilic adenoma.
   (*b*) Secondary hyperplasia: compensatory hyperplasia secondary to ovarian failure in young persons (pituitary migraine); postmenopausal hyperplasia.
4. Adrenal dysfunctions.
5. Breast hyperplasia, benign neoplasia, and occasionally cystic disease are lesions secondary to excessive estrogen effect on the breast. Treatment consists of x-ray castration in the suitable age group or, less preferably, direct breast irradiation under certain circumstances.
6. Roentgen castration for breast carcinoma.
7. Roentgen castration for carcinoma of the prostate.

RADIOLOGICAL SOCIETY OF NORTH AMERICA—ANNUAL MEETING

The Twenty-eighth Annual Meeting of the Radiological Society of North America will be held Nov. 30 to Dec. 4 at the Drake Hotel, Chicago. A program of great interest is being arranged.

Hedrich-Blessing Studio

The Drake Hotel, Lake Shore Drive, Chicago, Where the Radiological Society of North America Will Meet Nov. 30 to Dec. 4, 1942.

The usual Annual Refresher series will also be presented. Details of the courses appear elsewhere in this issue.

CORRECTIONS

In my Editorial on "Radiologists and Fractures," appearing in the August issue of RADIOLOGY, reference was made to a statement "by the late Dr. E. A. Merritt" to the effect that osteologic examinations still constitute the major portion of the clinical practice of radiology. The name should, of course, have been that of Dr. Merritt's former associate, "the late Dr. T. A. Groover." My apologies to Dr. Merritt, who is still actively engaged in practice. L. H. G.

In a paper by Dr. B. H. Nichols on "Thorotrast and the Diagnosis of Lesions Involving the Lower Spinal Canal," in the June 1942 issue of RADIOLOGY, the first sentence in the second column, page 682, should be corrected to read: "The introduction of intravenous saline solution, *0.45 per cent*, is started. . . ."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ACUTE INJURIES OF THE HEAD. THEIR DIAGNOSIS, TREATMENT, COMPLICATIONS AND SEQUELS. By G. F. ROWBOTHAM, B.Sc. (Manch.), F.R.C.S. (Eng.). With a Foreword by NORMAN M. DOTT, M.B., Ch.B. (Ed.), F.R.C.S. (Ed.). A volume of 288 pages with 124 illustrations. Published by The Williams & Wilkins Company, Baltimore, 1942. Price $7.50.

THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS. By JOHN ALBERT KEY, B.S., M.D., St. Louis, Mo., Clinical Professor of Orthopedic Surgery, Washington University School of Medicine; Associate Surgeon, Barnes, Children's, and Jewish Hospitals, and H. EARLE CONWELL, M.D., F.A.C.S., Birmingham, Ala., Orthopedic Surgeon to the Tennessee Coal, Iron and Railroad Company and the Orthopedic and Traumatic Services of the Employees' Hospital and to the American Cast Iron Pipe Company; Chairman of the Committee on Fractures and Traumatic Surgery of the American Academy of Orthopedic Surgeons; Member of the Fracture Committee of the American College of Surgeons, Associate Surgical Director of the Crippled Children's Hospital, Attending Orthopedic Surgeon to St. Vincent's Hospital, South Highlands Hospital, Hillman Hospital, Children's Hospital, Baptist Hospitals, and Jefferson Hospital, Birmingham, Ala. A volume of 1,303 pages with 1,259 figures. Third Edition. Published by the C. V. Mosby Company, 1942. Price $12.50.

OCCUPATIONAL TUMORS AND ALLIED DISEASES. By W. C. HUEPER, M.D., Assistant Director and Principal Pathologist, Warner Institute for Therapeutic Research, New York City. A volume of 896 pages. Published by Charles C. Thomas, Springfield, Ill., 1942. Price $8.00.

Book Review

DIRECTORY OF MEDICAL SPECIALISTS, 1942. Directing Editor, PAUL TITUS, M.D., American Board of Obstetrics and Gynecology. A volume of 2,495 pages. Published for the Advisory Board for Medical Specialties by Columbia University Press, New York, 1942. Price $7.00.

This second edition of the Directory of Medical Specialists has been greatly enlarged and now contains complete information about more than eighteen thousand certified diplomates. It is so arranged that a separate section is devoted to each of the Certifying Boards, with a geographic listing of its diplomates, with full biographical details. In addition, there is an alphabetic list of all diplomates, including the addresses and specialty certification.

An historical account of each board is given together with a list of the qualifications for eligibility for certification.

This volume is a valuable reference work for any practising physician and will find a special usefulness in libraries, hospitals, medical schools, editorial offices, and national and local medical organizations. For such, indeed, it is indispensable.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Earl R. Miller, M.D., University of California Hospital. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (University of California Medical School); second six months at Lane Hall (Stanford University School of Medicine).

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, W. R. Harwell, M.D. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, D. A. Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—*Secretary*, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—*Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—*Secretary-Treasurer*, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—*Secretary-Treasurer*, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—*Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—*Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—*Secretary*, Maurice Pomeranz, M.D., 1120 Park Ave., New York, N. Y.

Rochester Roentgen-ray Society.—*Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—*Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—*Secretary*, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—*Secretary*, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—*Secretary-Treasurer*, J. O. Newton, M.D., 13921 Terrace Road, East Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer*, Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—*Secretary-Treasurer*, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—*Secretary*, Barton R. Young, M.D., Temple University Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—*Secretary-Treasurer*, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary*, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—*Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—*Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—*Secretary-Treasurer*, L. W. Baird, M.D., Scott and White Hospital, Temple.

VIRGINIA

Virginia Radiological Society.—*Secretary*, Charles H. Peterson, M.D., 603 Medical Arts Bldg., Roanoke.

WASHINGTON

Washington State Radiological Society.—*Secretary-Treasurer*, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—*Secretary-Treasurer*, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—*Secretary*, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—*Secretary*, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Canadian Medical Association.—*Secretary*, W. J. Cryderman, M.D., Medical Arts Bldg., Toronto.

Section on Radiology, Ontario Medical Association.—*Secretary*, W. J. Cryderman, M.D., 474 Glenlake Avenue, Toronto.

Canadian Association of Radiologists.—*Honorary Secretary-Treasurer*, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—*General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive Tract

The Skeletal System

Gynecology and Obstetrics

The Genito-Urinary Tract

The Spinal Cord

RADIOTHERAPY

Malignant Tumors

Non-Malignant Conditions

Dosage

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Basilar Invagination of the Skull—So Called Platybasia: Report of Three Cases in Which Operation Was Done. W. McK. Craig, M. N. Walsh, and J. D. Camp. Surg., Gynec. & Obst. **74:** 751–754, March 1942.

The authors discuss the etiology, pathology, and symptomatology of basilar invagination of the skull, and report three cases in which operation was done.

It is pointed out that the term "platybasia," from an anthropological point of view, is more applicable to a flattening of the basal or sphenoid angle; while "basilar invagination" of the skull more aptly describes the upward bulging of the posterior cranial fossa around the foramen magnum, commonly known as platybasia. Neurological symptoms are to be expected in the latter type of case.

Basilar invagination may result from congenital anomaly, or secondarily from bone diseases in which softening of the calvarium occurs. Operation for relief of symptoms requires not only enlarging the foramen magnum but opening the dura, in order that the adhesions, which almost invariably form about the portion of the cerebellum and brain stem herniated through the foramen magnum, may be freed.

Three cases are presented. The first is that of a man of forty-six with evidence of involvement of the mid-line cerebellar structures, the right 5th cranial nerve nucleus, and the left 7th and 12th cranial nerves. The second patient was a sixteen-year-old boy who had nocturnal respiratory aberrations, difficulty in swallowing liquids, and progressive clumsiness of the hands. The third patient, a fifty-two-year-old man, complained of dizziness, and weakness and numbness in the legs. In all three cases basilar invagination of the skull was demonstrated by x-ray, and in all operations produced striking relief from symptoms.

The authors state they have had several patients with roentgenologically demonstrable basilar invagination of the skull without clinical signs or symptoms of nervous system involvement. Roentgenograms of a case in this interesting group are not reproduced in the present article. IVAN J. MILLER, M.D.

Atlas-Axis Dislocation Following Cervical Infection. Robert C. Martin. J. A. M. A. **118:** 874–875, March 14, 1942.

Dislocation of the axis on the atlas is often traumatic (frequently with fracture of the odontoid process and resultant damage to the cord), but it may also occur as a sequel to cervical infections. By producing hyperemia these infections cause vertebral decalcification of a greater or less degree. The ligaments are so strong that they cannot be avulsed without tearing off fragments of bone with them, but if the bone has undergone previous decalcification the ligaments yield readily. It has been shown that an inflammatory lesion anywhere in the upper cervical region may cause such decalcification and that it is peculiar to children at an age when the bones are imperfectly developed and not well calcified. The onset of the dislocation usually occurs about ten days after the onset of the infection. There is a slipping forward of one or both lateral articular facets of the atlas, with locking as the facet slips forward and downward over the opposing facet of the axis, or a slipping backward of one articular facet of the atlas.

The patient holds his head rigidly, slightly in front of the normal plane, tilted toward one shoulder, with the face rotated toward the opposite shoulder. There is no spasm of the sternomastoid muscle.

One may see an occasional case of torticollis preceding or following mastoidectomy and must be alert not to attribute it to an unconscious attempt on the part of the patient to relax an inflamed sternomastoid muscle on the diseased or operated side. In two of the author's cases dislocation was associated with mastoiditis. One case was associated with retropharyngeal abscess and another with severe nasopharyngitis. All were in children. Two cases occurring after tonsillectomy have been reported.

Reduction of the dislocation is accomplished by accentuating the deformity, in addition to traction, permitting unlocking of the lips of the lateral articular facets. Reposition of the vertebrae is secured by extension and by bringing the head to the mid-line while rotating the chin to its normal position. Fixation in plaster for a variable time allows healing and reattachment of the ligaments. The results in the four cases reported were good.

CLARENCE E. WEAVER, M.D.

Osteoma of the Maxillary Sinus. Robert E. Priest and Lawrence R. Boies. Ann. Otol., Rhin. & Laryng. **51:** 79–93, March 1942.

A general review of the subject of osteoma of the maxillary sinuses is given together with a report of two cases in which the lesion was treated conservatively by roentgen therapy. In both instances growth of the tumor was checked and the patients have remained symptom-free for eleven and two and one-half years, respectively.

There are several theories as to the etiology of these tumors, including an origin from cartilaginous rests and ossification of fibrous tissue laid down during the normal healing process. Small osteomas producing no symptoms may be accidental radiologic findings, and these probably are unusual but not rare. Larger ones are first noticed when they encroach on adjacent structures.

The most important diagnostic aids are roentgenography and biopsy. In the maxilla several other tumors occur more frequently than osteomas and must be considered in the differential diagnosis. These include dental root cysts, dentigerous cysts, adamantinomas, "mixed tumors," nasopalatine cysts, malignant tumors of the antrum, and giant-cell tumors.

Most authors believe the treatment of osteoma of the sinuses should be surgical. The results in the two cases reported by the authors suggest that radiation therapy may be employed to advantage with elimination of the dangers of surgery and the consequent facial disfigurement. L. W. PAUL, M.D.

Dry Hyperostotic Osteomyelitis of the Jaw. P. E. von Blatten. Schweiz. med. Wchnschr. **71:** 1498–1502, Nov. 29, 1941.

Although osteomyelitis is most common in the long tubular bones, localization in the jaw is not rare. Here the disease runs an acute course, with sequestration, bone pain, and fistula formation. An unusual type

is the hyperostotic form, which is often confused clinically with neoplasm. In the early stages soft tissue swelling and signs of inflammation are present, but regress to give place to a slow, indolent sclerosis and thickening of the bone. Roentgen study and often biopsy are necessary to make the diagnosis. In well developed stages the condition must be distinguished from Paget's disease, bone syphilis, and bone tumor.

This type of osteomyelitis is generally a disease of young people, and is more frequent in females. As a rule, anemia and prolonged clotting time are noted. In a case reported here, the blood calcium was elevated to 120 mg. per cent. LEWIS G. JACOBS, M.D.

Complete Cicatricial Stenosis of the Esophagus: Permeation Made Possible by External Operation in Certain Cases. F. D. Woodward. Ann. Otol., Rhin. & Laryng. **51:** 94–104, March 1942.

The most common cause of cicatricial stenosis of the esophagus is the accidental ingestion of lye by children or the swallowing of alkalis or acids, either accidentally or in an attempt at suicide, by adults. In the accidental group the majority of the strictures occur in the upper third of the esophagus, whereas in the suicide group, since a larger amount of the offending material is deliberately swallowed, the reaction can be expected to be further down and to be more severe.

At the University of Virginia Hospital, from which this report comes, acute cases receive emergency treatment—lavage with an appropriate neutralizing solution and insertion through the nose of a rubber feeding tube which is left in place for ten to fifteen days. The esophagus is not studied either by roentgen ray or the esophagoscope until an interval of three weeks or longer has elapsed. The majority of the patients, however, present themselves for treatment two to four months after the ingestion of the offending material because of increasing difficulty in swallowing, pain on swallowing, and loss of weight. In these cases a fluoroscopic study is done, followed by esophagoscopy. If the stricture is slight or moderate, dilatation is carried out with Jackson flexible bougies under vision, at increasing intervals. When the stricture is marked, the patient is referred directly to the department of surgery for a two-stage gastrostomy. When the gastrostomy has healed, an attempt is made to have the patient swallow a string. If this is successful, future treatment is carried out by the retrograde method of Dr. Gabriel Tucker. When all efforts at permeation of the stricture have failed, the patient must be condemned to a gastrostoma for life, run the risk of perforation in an attempt to permeate the stricture under the biplane fluoroscope, or undergo external surgical operation as advocated by the author. He reports three cases in which external operation was done, with success in two. The advances in thoracic surgery in recent years have been so great that today any portion of the esophagus is accessible to external exposure. L. W. PAUL, M.D.

THE CHEST

Nontuberculous Pulmonary Infections Complicating Pulmonary Tuberculosis. O. S. Baum and J. B. Amberson, Jr. Am. Rev. Tuberc. **45:** 243–279, March 1942.

In order to determine the effect of non-tuberculous infections complicating various types of pulmonary tuberculosis, the authors reviewed a series of cases observed by them from 1930 to 1941. All cases filed under a combined diagnosis of tuberculosis and lobar pneumonia, bronchopneumonia, suppurative pneumonia, lung abscess, or bronchiectasis were examined.

Pneumonia was found to be not rare in the tuberculous population. Although it is not always innocuous to tuberculous lesions, the great majority of these are not activated by a complicating pneumonia.

The authors' data on lung abscess seem to support the contention that activation of a tuberculous lesion depends primarily on direct invasion by the acute necrotic process and destruction of the capsule of the tubercle, if any exists. In 54 cases of lung abscess, activation of tuberculosis was conspicuous in 38. Thirteen cases which showed no evidence of previous tuberculosis showed evidence of tuberculosis beginning during the destructive phase of the abscess. This points to the need for careful sputum studies in all cases of pulmonary suppurative disease.

No definite conclusions could be drawn regarding the co-existence of bronchiectasis and tuberculosis. Bronchiectasis may result from a childhood tuberculous infection of the broncho-pulmonary nodes. Subsequent parenchymal tuberculosis in later life may be an exacerbation of post-primary apical hematogenous foci which were established concurrently with the bronchiectasis. In most cases, however, the origins of the two diseases seem to be separate. The incidence of tuberculosis in patients with bronchiectasis seems no greater than in the general population. Once it develops, however, it is more likely to progress because of the greater chance of dissemination by the copious bronchial discharge and by hemorrhage. Collapse therapy in these cases may arrest the tuberculosis but has little or no effect on the co-existing bronchiectasis.

L. W. PAUL, M.D.

Silicosis Among Naval Foundrymen. E. W. Brown and W. E. Klein. U. S. Nav. M. Bull. **40:** 42–52, January 1942.

This paper records a survey of the industrial personnel of the steel and non-ferrous foundries of the Naval Gun Factory of the Navy Yard, Washington, D. C., to determine the incidence of silicosis and the necessity for further protective measures. At the time (February 1939) the total mechanical personnel of the two foundries was 463 and in 454 of these examinations were satisfactorily completed. The procedure consisted of a detailed occupational history, a questionnaire as to present complaints, and a complete clinical examination of the lungs and circulatory system, including chest roentgenograms.

The roentgen findings were classified according to the scheme employed by the U. S. Public Health Service (see Flinn *et al.*: U. S. Public Health Bull. No. 244, 1939). Of the total number, 86.3 per cent fell in categories A and B, that is, having normal lung markings or first- and second-degree exaggeration of linear pulmonic markings, such as are observed in persons who have never experienced occupational dust exposure; 13.2 per cent were in categories C and D, defined, respectively, as "first degree diffuse ground glass appearance not obliterating linear markings, presenting fine discrete nodules stereoscopically and pathologically" and "second degree diffuse ground glass appearance obliterating linear markings, presenting fine

discrete nodules stereoscopically and pathologically." These are the earliest markings in the sequence of dust-induced changes which can be clearly differentiated from the changes that usually accompany age, bronchitis, cardiac stasis, etc. Only 2 patients, 0.4 per cent of the total, came under the E category, "first degree disseminated nodules up to the size of miliary tubercles." None were of classes F and G, that is, with larger disseminated nodules or coalescent nodules and conglomerate shadows.

Eleven cases of silicosis were diagnosed roentgenographically, 10 of stage 1 and 1 of stage 2. Three groups were involved: sand blasters, foundry chippers, and molders, the last group accounting for 7 cases, or 63.3 per cent. Seven of the men claimed to have no symptoms and gave negative results on physical examination and exercise tests. In none of the 11 was there any apparent occupational disability. [This would bear out the conclusions of Clement that silicosis is not a disabling disease, though that opinion is not universally held, as the discussion of Clement's paper indicates. See RADIOLOGY **37**: 407, 1941.]

Seventeen cases were interpreted roentgenographically as of the borderline or presilicotic type, that is, not definitely silicosis but with lung markings indicative of an initial trend thereto. Here again the molders were chiefly involved (76.5 per cent of the total). While a number of cases of tuberculosis were discovered in the survey, none of these was associated with silicosis.

The incidence both of silicosis and "pre-silicosis" bore a relation to the length of dust exposure. Of the 11 cases of silicosis, 1 occurred in the 10- to 14-year occupational duration group, 1 in the 15- to 19-year group, 2 in the 20- to 24-year group, 2 in the 25- to 29-year group, 3 in the 30- to 34-year group, 1 in the 35- to 39-year group, and 1 in the group aged 40 or over.

The minimum period of dust exposure for the borderline silicosis group was 10 years, the maximum 40 years. Of the 17 cases, 14 or 82.3 per cent occurred in the occupational duration groups of 25 to 29 years and above. In three instances only was there a record of less than 25 years' service.

Intrathoracic Goiter. Howard M. Clute and Knowles B. Lawrence. Am. J. Surg. **54:** 151–160, October 1941.

Intrathoracic goiters develop when a simple adenoma or one or more of the nodules of a multiple adenomatous goiter descend through the superior thoracic strait into the bony thorax. The usual source is a multiple adenomatous goiter, but occasionally a single discrete adenoma in the lower pole of one thyroid lobe will descend into the chest. Practically all intrathoracic goiters lie close to the trachea; most commonly they extend from the lower pole of either the right or left lobe of the thyroid, directly along the trachea, into the mediastinum.

Hyperplasia of the intrathoracic thyroid tissue may occur, with the development of toxic symptoms; it may undergo degenerative changes with necrosis, hemorrhage, and cyst formation, calcification, or malignant alteration.

Clinical symptoms are due largely to the pressure of the intrathoracic mass on the trachea, veins, or recurrent laryngeal nerve. Palpation may be helpful in diagnosis, and movement of the mass with deglutition, which occurs in an occasional case, is an important sign differentiating an intrathoracic goiter from a dermoid or other tumor.

The diagnosis of a substernal goiter can almost invariably be made roentgenographically but the pictures must be sufficiently soft to show the outline of the trachea. The trachea must be filled with air and the patient must hold his breath while the picture is being taken. Both anteroposterior and lateral views are necessary. In many cases the goiter itself will not show in the roentgenogram, and its presence will be known only because of the deviation of the trachea from the normal position in the mid-line. When the goiter is very large or when it contains much calcified material, its actual shadow will be visible.

Encapsulated Empyema. Harold Neuhof and Benjamin Copleman. Am. J. Surg. **54:** 39–49, October 1941.

The authors consider in this paper the special problems presented by smaller collections of pus in the pleural space, which are completely sealed off from the adjacent uninvolved pleura. Unlike diffuse empyemas, these localized empyemas are due in the vast majority of cases to suppurative pulmonary foci, usually perforated pulmonary abscesses, and this has been found to be true whether or not there is roentgen evidence of a pyopneumothorax and regardless of the presence or absence of a perforated pulmonary focus at operation.

Encapsulated empyemas differ clinically from the diffuse type in that the onset is frequently much more insidious. In some instances the symptoms are essentially those of the underlying abscess. In such cases invasion of the pleura is signalized by a sudden access of localized thoracic pain, sometimes, but not invariably, accompanied by reduction in cough and purulent expectoration. When symptoms of pulmonary abscess do not exist, the course is usually that of an acute pneumonic lesion in the initial phase, followed by low-grade fever. Only rarely does one encounter the evidence of respiratory distress, cardiac embarrassment, and toxemia that are frequently seen in diffuse empyema.

Features of special significance are the absence in many instances of any contact of the empyema with the chest wall, with consequent danger of infection of the free pleural cavity on exploratory aspiration or operation; the multilocularity of most of these localized pus collections; the frequent occurrence of adjacent bland pleural effusions; a roentgen appearance of "thickened pleura," which, however, may also be encountered after operations for non-suppurative lesions.

The diagnosis of an encapsulated empyema is based chiefly on adequate roentgen examination. The shadow of an encapsulated empyema is usually semi-ovoid in shape with the base against the chest wall. The inner margin may be straight, convex mesially, or scalloped if the collection is in the axilla. If it is situated at the anterior or posterior chest wall, only lateral or oblique views will demonstrate the limits of loculation. Two features are indicative of perforation of a pulmonary abscess: (1) the existence of a considerable area of homogeneous density with sharply defined convex margin, and (2) the existence of two (or more) adjacent areas of rarefaction as well as of two (or more) fluid levels.

Five groups of encapsulated empyemas are considered, each with its own roentgen features.

(1) Encapsulations over the convexity are the most common and may be located on the anterior, posterior, or lateral aspect of the chest wall. The smaller collections, occurring in conjunction with the shadow of a pneumonic lesion and revealing well defined margins, are usually recognized without difficulty. Large encapsulations offer a more serious diagnostic problem, especially if the pleural delimitation of a homogeneous shadow is not visible. In the multiloculated empyemas, which are of frequent occurrence, bizarre appearances are often seen. If surgical drainage has already been instituted, repeated radiographic examinations may be necessary to determine if loculations intercommunicate or to disclose other collections previously unrecognized. When pyopneumothorax occurs following the rupture of a lung abscess, even fluoroscopy and films made in many projections, with the patient in both the erect and lateral recumbent positions, may not suffice to distinguish between an intrapulmonary and an intrapleural lesion.

(2) Paramediastinal empyemas are situated on the mesial or mediastinal aspect of the general pleura and may present diagnostic difficulties because of the superimposition of shadows of the heart, great vessels, and other mediastinal structures. These collections may simulate cardiac enlargement, localized pericardial effusion, aortic aneurysm, or mediastinal tumor.

(3) Supra- or peri-apical empyema is rare. The x-ray film shows a homogeneous shadow extending downward for a variable distance from the dome of the hemithorax. The inferior margin of the shadow is usually sharp in outline. No air-bearing tissue is seen above this shadow. Malignant neoplasms may present closely similar features.

(4) Infrapulmonary empyemas—between the under surface of the lung and the upper surface of the dome of the diaphragm—may, if they are small, be overshadowed by adjacent pulmonary infiltration. Larger localized infrapulmonary encapsulations usually elevate and arch the diaphragmatic surface of the lung. As a result, a shadow is present at the base of the lung merging with the density of the liver (on the right side). The x-ray appearance may be indistinguishable from that of subdiaphragmatic abscess. A useful sign, though one not invariably present, is displacement of the heart away from the side of the lesion.

(5) Collections of pus in the interlobar fissures are strongly suggested by an oval or elliptical shadow limited by or overlying the region of the fissures or by the presence of a pyopneumothorax limited by the interlobar pleura. A fluid level abutting on or traversing a fissure also points to the possibility of an interlobar collection. In about half the cases studied by the authors distinctive roentgen findings were absent.

Because of the difficulties of diagnosis, thoracentesis is frequently indicated, preceded by complete roentgen study to determine the correct site for exploratory puncture. Precise roentgen localization is also a prerequisite for operative treatment. This consists in evacuation of the main collection of pus and of communicating locules, followed by treatment of the associated pulmonary abscess.

Bronchial Obstruction: Signs, Symptoms, and Diagnosis. Paul Holinger and Albert H. Andrews, Jr. Am. J. Surg. **54:** 193–210, October 1941.

This paper is concerned chiefly with the mechanics of bronchial obstruction and the signs and symptoms which it produces. The physiologic effects of obstruction the authors divide into respiratory and cardiovascular. "Mild obstruction results in a dyspnea which remains compensated by reflex and physiochemical stimulation. Severe obstruction results in respiratory decompensation, or anoxia. The cardiovascular phenomena manifest themselves by a pulmonary edema and finally circulatory failure due to rising intrathoracic negative pressures."

A division of the lesions responsible for bronchial obstruction into intrabronchial, endobronchial, and extrabronchial groups serves as an etiologic classification. In the intrabronchial group fall foreign bodies, postoperative massive collapse of the lung, the obstructions produced by exudates in laryngotracheobronchitis, and atelectasis due to the thick plugs of asthma. Endobronchial obstructions are due to lesions of the bronchial mucosa, musculature, or cartilaginous wall, while extrabronchial factors include mediastinal, cardiac, or pulmonary lesions which produce their effect on the bronchi by external pressure.

Mechanically there are four types of obstruction, acting as valves in a system of tubes: (1) Obstruction of the *by-pass valve type* causes only a slight decrease in the bronchial lumen, permitting the passage of air to and fro without appreciably changing the volume of air entering or leaving the lung beyond the point of obstruction. (2) A second type of obstruction, more marked than the first, is designated the *check-valve type.* It permits passage of air in one direction only and is dependent upon the bronchial expansion and contraction occurring in normal respiration. Thus if a foreign body lies in the bronchial lumen, air may pass it freely during inspiration, as the bronchus increases in size. During expiration, however, the bronchial wall collapses and the flow of air out of the lung distal to the foreign body is prevented. As this process is repeated, more and more air becomes trapped and an emphysema develops. (3) The *ball-valve type* of obstruction differs from the check-valve type in that the obstructing element moves back and forth, in and out of the valve seat, but the effect is in general similar. (4) Complete obstruction—the *stop-valve type*—permits neither ingress nor egress of air, and the lung beyond the point of obstruction becomes airless and shrunken or atelectatic.

The roentgen aspects of the diagnosis of bronchial obstruction depend upon a complete roentgenographic study of the chest. Fluoroscopically, areas of density or emphysema, the motion of the diaphragm, and the shifting position of the heart and mediastinum on inspiration and expiration are significant. Unless the obstructing element is itself an opaque object, there are no roentgen findings in the by-pass type of obstruction. With ball-valve or check-valve obstruction there are demonstrable fluoroscopically an increase in the transparency of the affected lung, a depression and limitation of motion of the diaphragm on the involved side, displacement of the heart and mediastinal structures toward the uninvolved side on expiration, and a compensatory increase in motion of the diaphragm on the uninvolved side. In complete obstructions of the main bronchi, the well known findings are the shift of the heart and mediastinal structures toward the involved side during both phases of respiration, the elevation and fixation of the diaphragm on the involved side, and the density of the atelectatic lung. These

findings are associated with a compensatory emphysema of the opposite side.

The technic of bronchography is described and roentgenograms are reproduced.

Primary Bronchogenic Carcinoma of the Lung. A Clinical and Roentgen Study of Thirty-eight Cases over a Period of Twelve Years. Harry A. Olin and Clinton A. Elliott. Am. J. Surg. **54:** 614–628, December 1941.

The 38 examples of bronchial cancer reviewed by the authors occurred among 815 cases of malignant growth seen over a period of twelve years, representing 4.7 per cent of the latter group. The series is no exception to the rule that most cases are seen at a stage too advanced for effective therapy and it emphasizes afresh the importance of early diagnosis, through the cooperation of clinician, bronchoscopist, and roentgenologist.

There are no roentgen findings which are in themselves pathognomonic of bronchial carcinoma, but the roentgenologist may be of great aid in fortifying the suspicions of the clinician or even in suggesting the diagnosis. Of the roentgen findings, the first importance is assigned to a unilateral shadow at the hilum which is not due to increased vascular markings and whose border may be well circumscribed or may fade into the parenchyma as a "feathery" cloudy density. This shadow is considered one of the earliest signs of bronchial hilus carcinoma. Next in importance is atelectasis of greater or less extent due to bronchial obstruction. The resulting collapse displaces the heart, trachea, and mediastinum to the affected side. In the presence of secondary infection, multiple small abscess cavities occur. Usually the atelectatic area is roughly triangular in shape and if small may have a well defined border. Eventually, large areas of infiltration cause consolidation of part or the entire lobe or lung and are visualized as dense massive shadows. Pleural effusion, if present, may conceal the tumor. In view of this the authors make it a policy in such cases to carry out chest studies as soon as possible after removal of the fluid. In several of their patients even large effusions failed to displace the heart, and this finding they have come to consider as suggestive of cancer.

Primary Carcinoma of the Bronchus: An Analysis of Fifty-six Cases. Thomas J. White, Samuel Cohen, Angelo M. Gnassi, and Preston Price. J. A. M. A. **118:** 862–865, March 14, 1942.

Fifty-six histologically proved cases of bronchogenic carcinoma were observed by the authors during a period of eight years.

Clinical Features: A large proportion (88 per cent) of the patients were men. The average age was fifty-six years. The average interval from onset to hospitalization was 6.6 months. Death occurred on an average of 3.1 months later. In 22 cases, or almost 40 per cent, the duration of life in this second phase did not exceed one month.

The usual mode of onset was insidious. Cough was by far the most common symptom (91 per cent) and one of the earliest. Seven patients had foul expectoration associated with secondary abscess formation. Dyspnea was noted in 59 per cent. One half complained of thoracic pain. Hemoptysis appeared in 41 per cent. Weakness and weight loss were noted in 87 per cent. Some had limitation in motion of the affected hemithorax. Local pressure might cause dysphagia, hoarseness, or a Horner's syndrome. Enlarged superficial lymph nodes were noted 19 times. Effusion into the pleural cavity was often encountered.

Diagnosis: The most common roentgenographic appearance is a unilateral density which radiates outward from the hilus. Inflammatory changes involving the parenchyma and the bronchi occur distal to the tumor, and it is these changes together with pleural involvement which contribute largely to the roentgen opacity. In 7 cases a definite abscess cavity was noted on the film. Mediastinal widening was seen in 9 cases. Ninety-one per cent of the series arose from the main or first division bronchi and therefore were of hilar type. These are non-circumscribed. Seven per cent were peripheral and circumscribed. Two per cent were diffuse nodular carcinomatosis. A slight preponderance in the right lung was observed. Bronchoscopy with biopsy is probably the most important single procedure for diagnosis. Corroboration may be made by microscopic study of lymph nodes.

No benefit was obtained with any form of therapy.

Histopathology: Group 1, epidermoid carcinoma, accounted for 23 cases, or 62 per cent of the total of 37 that came to autopsy. There were 4 Group 2 cases, adenocarcinoma, representing 11 per cent of the series. In Group 3, the undifferentiated type of carcinoma, there were 9 cases, or 24 per cent of the total. Group 4, or the mixed type, is represented by a single patient.

No definite correlation was noted in this series of cases between the clinical course, the duration of life, and the histopathologic type of the tumor. An effusion on the same side as the tumor was noted in 59 per cent of these patients. Sanguineous effusion was relatively infrequent.

The present outlook indicates that thoracic surgery (lobectomy or more often pneumonectomy) offers the best chance for cure. CLARENCE E. WEAVER, M.D.

Accessory Methods in the Diagnosis of Primary Carcinoma of the Lung. Lew A. Hochberg. Dis. of Chest **8:** 70–78, March 1942.

Early carcinoma of the lung is first suspected by the roentgenologist after the clinician begins thorough investigation of an atypical pulmonary complex. The author mentions accessory methods by which this suspicion may be confirmed. These are: cytologic studies of sputum, cytologic studies of the pleural fluid, lung puncture for biopsy studies, exploratory thoracoscopy and removal of tissue for biopsy, exploratory thoracotomy. Cases are recorded to illustrate each of these methods.

It may be pointed out, by way of comment, that the low mortality of exploratory thoracotomy makes the use of lung puncture, involving the possibility of seeding of the malignant process or infection of the pleura, an unnecessary hazard; also that no method which can be applied to the study of carcinoma of the lung is sufficient in itself, in the hands of the average clinician and pathologist, for a diagnosis of carcinoma of the lung, with the exception of direct microscopic examination of the lesion. WM. H. GILLENTINE, M.D.

Clinical and Anatomical Study of Neurological Conditions Resulting from Metastases in the Central Nervous System Due to Carcinoma of the Lung. Review of One Hundred Cases. Arthur B. King and Frank R. Ford. Bull. Johns Hopkins Hosp. **70:** 124–156, February 1942.

A number of writers have recorded the acute onset of

neurological symptoms subsequently found to be due to metastases from primary lung cancer. The present authors review the literature and report a study of 100 cases of pulmonary cancer (not including pleural endotheliomas or sarcomas) in which a complete postmortem study was made of the chest and central nervous system.

Metastatic deposits in the central nervous system were found in 27 of this series of 100 cases, the incidence being comparable to that reported by others. In 20 of the cases the brain lesions were multiple, being scattered indiscriminately throughout the brain, in the cortex, central white matter of the hemispheres, brain stem, cerebellum, and hypothalamus. The individual deposits were rarely more than 1.0 cm. in diameter. When larger tumors were found they frequently showed central necrosis. When the spinal cord was involved the metastasis was in the spinal meninges or in the vertebrae; the substance of the cord was never involved.

The cases are classified in six groups.

(1) In 8 cases the neurological signs were consistent with a single lesion in the brain. In 5 of these the onset was marked by convulsions and in 3 of these focal signs followed immediately. The picture in general resembled that produced by a primary neoplasm of the brain or by vascular disease.

(2) In the second group, consisting of 6 cases, the signs were suggestive of multiple cerebral lesions, including hemiparesis, speech difficulties, nystagmus, cerebellar ataxia, hemianesthesia, cranial nerve palsies, hallucinations, and stupor. In most cases of this type the author believes there is sufficient clinical evidence for a correct diagnosis.

(3) Six cases were characterized chiefly by stupor, and focal signs were absent or not impressive. In all of these cases the primary process in the lungs was clinically silent and in none was a correct diagnosis made.

(4) A single case showed deposits in both the brain and spinal cord, leading to a confusing clinical picture. A correct diagnosis was made only at autopsy.

(5) In 4 cases the cerebral lesions were silent. The deposits in one case involved the infundibulum and anterior lobe of the hypophysis and no doubt caused metabolic disorders which were overlooked. In another there were deposits in the occipital and parietal lobes, and in a third a single nodule in the right frontal lobe of the brain. In a fourth there was a solitary small metastatic nodule in the left thalamus. The predominant symptoms in these cases were due to the pulmonary lesion.

(6) In 4 cases the spinal cord alone was involved. There was paraplegia in 2, due to lesions in the thoracic region. Tetraplegia due to compression of the cord above the cervical enlargement was present in another case, and in the fourth case the roots of the cauda equina were involved, causing sacral anesthesia and incontinence. The neurological picture was that of a single lesion in each case, probably because the highest lesion masked the presence of the others.

The 27 cases are reported in detail and the symptoms and signs are analyzed, leading to the following conclusions:

(*a*) Focal signs are usually mild and incomplete. They are frequently of rapid onset and development and occur so abruptly as to suggest emoblism, thrombosis, or hemorrhage.

(*b*) Not infrequently convulsions mark the onset of nervous symptoms, and these are frequently followed by hemiplegia.

(*c*) Headache is very frequent but papilledema is uncommon, being present in only 5 of the 27 cases observed.

(*d*) Signs of meningeal irritation are rare.

(*e*) Mental disturbances are common but not characteristic. Drowsiness passing into stupor and coma is most frequently observed. Delirium and excitement are rare. Hallucinations were noted once in this series and suicide was attempted by one patient.

(*f*) The spinal fluid pressure is rarely elevated but there is usually an excess of protein. When the spinal cord is involved, Froin's syndrome may occur.

(*g*) Roentgenograms of the skull and bones rarely reveal metastases in patients with neurological signs. On the other hand, the bones may be riddled with metastases and at autopsy the brain will not be involved.

(*h*) Ventriculography may reveal normal ventricles, dilated ventricles, signs of a mass within the cranium, or multiple filling defects in the walls of the ventricles, a condition which is suggestive of metastases. It was found difficult to make a positive diagnosis of multiple tumors by this method.

(*i*) The growth in the lungs may be silent at a time when the neurological symptoms are well advanced. In this series of 27 cases, the neurological features were predominant in 14.

(*j*) If the process in the lung is detected, it may be mistaken for tuberculosis, abscess of the lung, Hodgkin's disease, lymphosarcoma, etc.

(*k*) Deposits in the kidneys and other viscera rarely give rise to any recognizable symptoms. The adrenal glands are affected in a high percentage of cases and it is possible that this may influence the clinical picture. Deposits in the hypothalamus and anterior lobe of the hypophysis may cause somnolence or stupor. Deposits in the skin or lymph nodes may be found in some cases and permit a correct diagnosis by biopsy.

In the light of the above statements, it seems wise to have a careful roentgenographic study made of the chest in all cases in which there is reason to suspect an intracranial neoplasm, in all cases in which there is reason to suspect a spinal cord neoplasm, and in all cases of unexplained stupor.

Pulmonary Cysts. Herbert C. Maier. Am. J. Surg. **54:** 68–81, October 1941.

The term "pulmonary cyst" has been applied to a wide variety of pathological processes in the lung. Of these the author discusses at the greatest length congenital pulmonary cysts. These may be fluid- or air-containing, single or multiple. Symptoms may appear shortly after birth or may develop only in adult life, or the cyst may be discovered incidentally on roentgen examination or at necropsy.

In the clinical diagnosis the roentgenographic findings are of the first importance. The fluid cyst appears as a round or oval area of increased density; if it communicates with a bronchus a fluid level may be present. Air-filled cavities appear as round or oval areas of increased radiolucency. The location and contour of the radiolucent area may serve to differentiate an intrapulmonary cavity from a localized pneumothorax. In expansile cysts there may be evidence of compression

of the surrounding pulmonary parenchyma. Large positive pressure cysts may occupy almost an entire hemithorax and may even displace the mediastinum toward the opposite side. This latter type of cyst is frequently incorrectly diagnosed as a tension pneumothorax. The two conditions can usually be differentiated roentgenographically, however, since in the case of the cyst there is no prominence at the pulmonary hilum representing collapsed lung and the costophrenic sinus contains compressed pulmonary tissue.

Roentgen examination may also—though not always—serve to differentiate an infected pulmonary cyst from empyema. The outline of a cyst is spherical or oval in both postero-anterior and lateral projections, whereas the outline of an encapsulated empyema may be triangular or fusiform and conforms more to the contour of the thoracic cage or neighboring structures in the region it occupies. Little evidence of pleural thickening may be seen on the roentgenogram of a person with a pulmonary cyst even though the infection is of many months' standing. The combined thickness of the cyst wall and pleura may be less than the thickening of the parietal pleura alone in cases of chronic empyema. If the infected cyst cavity is for the most part filled with air, the roentgenogram may show strands of pulmonary tissue traversing the cavity, and the correct diagnosis should then be suspected.

The term cyst is also applied to cavitation in the lung parenchyma persisting in cases of pulmonary suppuration after subsidence of the infection, with ingrowth of epithelium from the communicating bronchi. If roentgen studies have been made during the course of the acute infection, the origin of the cavity may be readily evident. If, however, the patient is first seen after the cavity has become empty of pus and the surrounding pulmonary infiltration has cleared, the condition may be confused with a congenital cyst or a pneumatocele. The latter usually has a thinner wall and may show considerable fluctuation in size.

Emphysematous bullae are probably better considered as a locally advanced stage of pulmonary emphysema than as cysts. They require differentiation from localized pneumothorax, pneumatocele, and pulmonary blebs. The latter are collections of air in the interstitial tissues of the lung, due to rupture of alveoli. Their manifestations are acute, and differentiation from other cyst-like lesions is not difficult.

A pneumatocele is a hyperinflated cavity produced by distention of a defect in the pulmonary parenchyma. It may show marked fluctuation in size on serial roentgenograms, reaching huge proportions in infants and children. The cavity may be entirely air-containing or a fluid level may be demonstrable due to the presence of both air and fluid. Differentiation from congenital pulmonary cysts and large abscess cavities is important, as surgery is seldom indicated.

Of parasitic cysts the most important is the echinococcic or hydatid cyst. This appears on the roentgenogram as a round or oval area of increased density. The borders of the shadow are less sharply defined than in the case of solid tumors. The shadows may be single or multiple. There may be evidence of associated pleural involvement.

The treatment of the various types of cavitation or cyst formation is discussed, and the importance of a correct diagnosis in view of the diverse therapeutic indications is stressed.

Mechanism of Closure of the Ductus Venosus. A. E. Barclay, K. J. Franklin, and M. M. L. Prichard. Brit. J. Radiol. **15:** 66–71, March 1942.

In the course of investigation of the circulation of ewes new-born by cesarean section, with the aid of an opaque medium and cineradiography, the ductus venosus was seen to close and open intermittently, sometimes at the rate of three times a second. Observation of this phenomenon led to the conclusion that there is a sphincter at the beginning of the ductus. Histological studies of this region, as yet incomplete, also indicate the presence of such a sphincter.

SYDNEY J. HAWLEY, M.D.

THE DIGESTIVE TRACT

Gastroscopic Differential Diagnosis of Benign and Malignant Ulcer of the Stomach. R. Schindler and O. Arndal. Arch. Surg. **44:** 473–488, March 1942.

Roentgen examination is superior to gastroscopy in the diagnosis of gastroduodenal ulcer, but some gastric ulcers which escape roentgen detection can be diagnosed by the latter method. Its principal use is to differentiate benign from malignant ulcer. The fact that a number of errors in distinguishing these conditions were observed led to the analysis of 113 cases, of which 79 were proved to be benign ulcers and 34 malignant.

Among the signs favoring benign ulcer is the existence of a perfectly sharp edge without a surrounding wall. This sign was present in 72 of the 79 benign cases, and in only 1 of the 34 malignant ulcers. It is considered one of the best gastroscopic signs of benignity. Sharpness, however, must not be confused with regularity of the edge. Only in benign ulcer is complete absence of infiltration of the mucosa found. This sign was present in 26 of the 79 benign ulcers studied. It is inconsistent with the belief that gastritis is present in ulcer patients, which the authors deny. Mucosal hemorrhages and pigment spots in the mucosa are more frequent in benign ulcer, being found in 15 of the 79 benign lesions and only 1 of the 34 malignant lesions; this sign is of value, however, only if the surrounding mucosa is unquestionably normal. Henning's sign—an arch-shaped distortion of the angulus—is not frequently present, but if observed favors benign ulceration. A fold which may be seen projecting toward the ulcer as the gastroscope is withdrawn from the lower loculus is present only in benign ulcer; in malignant lesions producing an hour-glass deformity the gastroscope could not be passed into the lower loculus. Radiating folds from the crater are less frequently seen at gastroscopy than at roentgenoscopy, but when present indicate benignity; they were observed in 16 of the 79 benign cases but in only 1 of the 34 malignant ulcers. Normal mucosa distant from the ulcer, a uniform color of the wall and surrounding mucosa, and mucosal islands in the ulcer are inconclusive signs, which are no proof of benignity.

The presence of a limiting wall on one side and blending infiltration on the other speaks in favor of malignancy. This was not found in any benign ulcer, but was present in 11 of the 34 malignant ones. Large tumor nodes and masses in the surrounding area are suggestive of malignancy but occasionally may occur in benign lesions. Irregular ridges or nodes on the ulcer floor are seen only in malignant ulcers, but the nodulation must be irregular; regular nodules may be pan-

creatic lobuli exposed by the ulcer. Diffuse infiltration of the whole stomach, whether or not the ulcer is visualized, is very highly significant of malignant growth. White crystalline material floating on the ulcer floor is identical with the necrotic material on the floor of malignant ulcers seen by pathologists. The floating phenomenon is found only in malignant ulcers. Ulcers in the antrum close to the greater curvature are predominantly malignant. Such an ulcer is to be diagnosed as benign by gastroscopy only if there are no associated signs which might lead to doubt. A visible ulcer in the pylorus is usually malignant, since the scarring of a benign ulcer here pulls the crater out of sight of the gastroscopist. Bleeding of the edge of a malignant ulcer is often noted, while benign ulcers, if they bleed at all, usually bleed from the center or floor. Some malignant ulcers show a dark red wall in striking contrast to the pale normal mucosa, a sign never noted in benign ulcer. The typical benign ulcer has a sharply cut edge, while malignant ulcers have an edge that blends imperceptibly with the normal mucosa. Occasionally a benign ulcer may show a few millimeters of such blending, but when present the sign casts doubt on the benign character of the lesion. Small ulcerations in the wall surrounding benign ulcer are not found, and they are rare in the neighboring mucosa. If present they speak for malignancy.

Signs which do not prove malignancy are large size of the ulcer, the presence of atrophic gastritis, infiltration about the ulcer, callous or edematous wall, ragged edge, a hill-like elevated area (previously thought by Schindler to be characteristic of malignancy), the presence of necrotic material on the ulcer floor (it may be food!), or regular nodulation of the floor.

Eight case reports, illustrating both indefinite diagnoses and errors of diagnosis, are included.

LEWIS G. JACOBS, M.D.

Ileocolic Intussusception: Diagnosis by X-Ray without Contrast Media. Joseph Levitin. Am. J. Surg. **54:** 494–498, November 1941.

Numerous papers have been published describing the demonstration of intussusception following a barium enema. The author reports two cases of ileocolic intussusception in which the diagnosis was made on the basis of flat films without the use of barium and suggests the more frequent use of this procedure. The findings in both cases were typical. In each instance two gas-distended loops of bowel, one within the other, were seen in the right lower quadrant. The dilated intussuscipiens was readily recognized as cecum. Within this dilated loop was the second loop narrowed at its lower end, *i.e.*, the neck of the intussusception. In one case reduction was accomplished by a barium enema; in the other operation was required.

The author adds a note referring to Abrams' contribution on the roentgen diagnosis of intussusception without the use of opaque media (RADIOLOGY **36:** 490, 1941), appearing after his own paper was completed. Other references are given and roentgenograms and diagrammatic drawings are reproduced.

Syphilis of the Stomach. Walter Wessels. Urol. & Cutan. Rev. **46:** 148–152, March 1942.

Autopsy findings of syphilis of the stomach are rare; only 2 cases were observed in 27,000 postmortem examinations at the Los Angeles General Hospital. Clinically the number of cases encountered is much greater. Diagnosis is based on a positive Wassermann reaction, favorable response to anti-syphilitic therapy, and a roentgen picture simulating either gastric ulcer or cancer.

The roentgen findings, which the author quotes from Moore and Aurelius (Am. J. Roentgenol. **19:** 425, May 1928), are as follows: (1) a concentric, symmetric filling defect affecting both curvatures equally and narrowing the gastric lumen, the narrowed channel being straight and smooth; (2) obliteration of gastric rugae and loss of gastric wall pliability; (3) the occurrence of stenosis in the pyloric rather than the cardiac portion of the stomach (seen in about three-fourths of the cases); (4) an hour-glass type of stomach (seen in less than half the cases), the constricted canal being rather long; (5) conversion of the entire stomach into a narrow smooth tube, seen in less than a tenth of cases; (6) loss of peristalsis in the affected areas and sluggish peristalsis in uninvolved areas.

The chief gastroscopic finding is chronic gastritis. Pathological studies reveal an infiltration of the mucosa and muscularis. Ulceration is secondary. Proliferating endarteritis and panphlebitis are almost always present. Symptoms are not characteristic. In gastric syphilis, in contradistinction to cancer, a mass is seldom palpable, cachexia and anemia are absent, and the period of highest incidence is in the third decade. Treatment is that for any form of late syphilis, with appropriate dietetic measures.

Two cases are reported, both in patients under forty years of age. In one case, syphilitic therapy was successful; in the other surgery was necessary and the diagnosis of syphilis was confirmed.

MAURICE D. SACHS, M.D.

Logical Approach to Subphrenic Abscess. Henry H. Faxon. Am. J. Surg. **54:** 114–126, October 1941.

This paper is based on 124 cases of subphrenic abscess treated by surgical drainage at the Massachusetts General and associated Baker Memorial Hospitals during the years 1900–41.

The prime requisite for prompt recognition and intelligent treatment of these lesions is thorough familiarity with the subdiaphragmatic region and its divisions. The right subphrenic spaces are by far the most frequently involved. In the series recorded, 154 spaces were involved: the right posterior superior 55 times (36 per cent), the right anterior superior 42 times (27 per cent), the right inferior 28 times (18 per cent).

The most usual primary sources of a subphrenic abscess are appendiceal peritonitis (31 per cent of the author's series), gastric and duodenal lesions (30 per cent), and disease of the liver and gallbladder (19 per cent). The occurrence of an antecedent intraperitoneal infection is suggestive of the diagnosis and this is rendered more probable by the presence of a high fixed diaphragm, fluid or gas beneath that structure, localized tenderness, and pleural effusion. Preoperative roentgen studies were made in only 96 of the cases in this series and in 17 the outline of the diaphragm was obscure. In 95 per cent of the cases in which it could be demonstrated it was elevated.

Surgical drainage is the accepted method of treatment. The retroperitoneal approach is applicable in about four-fifths of the cases; it is attended with the

lowest incidence of contamination of uninvolved serous cavities and carries with it a lower mortality rate than other types of operation. For abscesses in the posteromedial portions of both the right anterior superior and left superior spaces, though these can be reached by the retroperitoneal approach, the transpleural type of operation would seem more desirable. The transperitoneal approach is the only one available for drainage of the left inferior spaces.

Contamination of uninvolved serous cavities is of grave prognostic import. It occurred in 41 of the author's series and the mortality in this group was over two and one-half times as high as in the uncontaminated cases, 63 as compared with 24 per cent.

THE SKELETAL SYSTEM

Chronic Sclerosing Osteomyelitis: Garré. D. Rees Jensen. Am. J. Surg. **54:** 377–383, November 1941.

A woman of 28 gave a long history of recurrent pain in the joints, suggestive of rheumatoid arthritis. With the attacks of pain there was some elevation of temperature and the leukocyte count was slightly increased, without significant change in the percentage of polymorphonuclears. There was no history of antecedent infection or trauma. Roentgen studies showed thickening of the cortex and medulla of the right femur with some periosteal irregularity and linear shadows of increased density in the soft tissues posteriorly. In the superior portion the thickening was fairly uniform, but there was a multiple cystic appearance culminating in a large cystic area in the lateral condyle. The diagnosis lay between chronic osteomyelitis and a malignant bone tumor. Because of the persistent pain, operation was undertaken and the diagnosis of chronic sclerosing osteomyelitis was established. A generous portion of the ivory-like cortex was removed on two occasions with an interval of four weeks, and a long period of rest (four months) was enforced with good results. Subsequently, however, pain recurred and a third operation was undertaken, two years after the second. The recurrent symptoms were found to be due to a subacute ligamentous inflammation, which subsided after removal of the involved tissue followed by roentgen therapy and rest. Fifteen months later the patient was relatively well, though periodic attacks of mild pain continued.

The pathological findings in chronic sclerosing osteomyelitis are attributable to persistent irritation of the bone by an infectious agent, usually, as in this case, a *Staphylococcus aureus* of low virulence. The chief difficulty in diagnosis is differentiation from sarcoma. A duration of years with acute onset and chronic course is suggestive of chronic osteomyelitis. The roentgen findings in the two conditions are easily confused and biopsy may be necessary for a diagnosis.

Osteochondritis and Tuberculosis: A Demonstration of Cases of Calvé's Disease of the Spine and Köhler's Disease of the Tarsal Scaphoid, with a Discussion of Their Relationship to Tuberculosis. A. Dale. Edinburgh M. J. **49:** 34–39, January 1942.

Two cases of Calvé's disease are considered in this paper, details of one of which have been presented elsewhere (Brit. J. Surg. **25:** 457, 1937). These cases were found in a ten years' experience of surgical tuberculosis, for which the disease may easily be mistaken. It is, however, of much less frequent occurrence, for in the same period 336 cases of spinal tuberculosis were encountered.

Calvé's disease usually comes to the attention of the physician as a probable early or mild tuberculous caries of the spine and, except for a possible negative tuberculin reaction, is not to be distinguished in its initial stages from the latter condition. The progress, however, is uncomplicated by abscess formation, paraplegia, or gross deformity, and the prognosis is thus more favorable than that of Pott's disease. The roentgen picture is characteristic. The body of the vertebra is reduced to a thin disc of increased density—the *vertebra plana*. The intervertebral spaces are hardly affected. They are not reduced as in tuberculosis and, indeed, may be wider than normal, in accordance with the formula for osteochondritis—less bone and more cartilage. Regeneration of the vertebral body occurs to a considerable degree, although the body never resumes its normal size. Such regeneration does not occur in tuberculosis. Finally, only one vertebra is affected. This is important, for tuberculosis of the spine always affects at least two bodies.

Because of the possible light it may shed on the etiology of Calvé's disease, a case of Köhler's disease of the tarsal scaphoid associated with tuberculosis is also presented. Most orthopedists admit the association of these two conditions. Is there any association, the author asks, between tuberculosis and other conditions classed as osteochondritis? The latter, he concludes, "*may be* mild tuberculous or mild infective lesions and the characteristic x-ray appearance may simply represent the response of developing bone, at certain sites, to a mild infection, tuberculous or otherwise."

A number of roentgenograms are reproduced.

A Contribution to the Pathogenesis of Spondylitis Ankylopoietica. Ernst Freund. Edinburgh M. J. **49:** 91–109, February 1942.

The author reports a study of a part of the lumbar spine removed at autopsy from a patient dying of cancer of the kidney with pulmonary metastases. The patient had complained of pain and stiffness of the joints for six years and his back had eventually become so stiff that bending was impossible.

The section of the spine examined included three complete discs with two vertebral bodies between them, besides the adjacent parts of the neighboring vertebrae above and below, the total extent being from the first to the fourth lumbar vertebra.

The well known appearance of the spine resembling a bamboo stick as seen in the x-ray photographs of this condition was easily recognizable in the specimen. The transverse sections of the lumbar arteries were visible, being situated below the summits of the elevations corresponding to the discs. In the x-ray photographs the discs seemed to be preserved, although somewhat irregular in shape. The lowest disc was also diminished in thickness. Irregular opacities of different size were visible within the discs, which may represent irregular endochondral ossification. The vertebrae as a whole did not exhibit any remarkable changes. Their upper and lower outlines were uneven, especially in the third, due perhaps to ossification of parts of the discs from the adjacent bone. In the x-ray photograph taken in the anteroposterior direction increase of the diameter of the lumbar vertebrae in

the region of the discs is obvious; here also bony bridges are visible.

The greater part of the author's discussion is concerned with the histologic findings and these are illustrated by thirteen photomicrographs. In the intervertebral articulations all gradations from fibrous to osseous ankylosis were encountered; slight evidence of chronic inflammation was present. The articular processes of the vertebrae showed, in various areas, coarse fibrous tissue exhibiting chronic inflammatory changes, but no specific appearances of typical rheumatic lesions. No signs of degenerative changes were seen within the intervertebral articulations. The discs showed replacement of cartilage and nucleus pulposus by vascular fibrous tissue. This replacement of cartilage by connective tissue, however, has nothing to do with ossification, which is absent at first, and, if it does occur later, is a secondary process due to mechanical causes. The formation of osseous bridges between two adjacent vertebral bodies was a striking feature. This also is probably due to mechanical demands. Ossification of the ligament was found in an initial stage only and is not to be held responsible for the stiffening of the spine in this case.

The author does not agree with those clinicians who regard spondylitis ankylopoietica as merely a rheumatoid condition. He recognizes two types: a genuine form without previous infection and an incidental type occurring in the course of, or following, rheumatic fever or other infections. In their late stages both rheumatoid arthritis and spondylitis ankylopoietica may cause extensive rigidity of joints and spine and rheumatoid arthritis may involve the small articulations of the spine, producing a clinical picture of spondylitis ankylopoietica, but the progress of the two conditions is different.

Brucellosis Spondylitis: Treatment by Physically Induced Hyperpyrexia. George S. Phalen, Louis E. Prickman, and Frank H. Krusen. J. A. M. A. **118:** 859–862, March 14, 1942.

Spondylitis is probably the most common complicating disorder of the bones and joints referable to undulant fever. Cases have been reported in which localization in the spinal column developed as early as three weeks and as late as one year after the original infection. Farmers, veterinarians, dairymen, butchers, and packing house employees complaining chiefly of backache should be suspected of brucellosis spondylitis. It may also be suspected in those giving a history of ingestion of raw milk.

Since 1938 three patients having brucellosis spondylitis have been treated by physically induced hyperpyrexia at the Mayo Clinic. Gratifying results have been obtained. The effect of hyperpyrexia in the treatment of brucellosis has never been satisfactorily explained. It may be one of activation or heightening of the intrinsic protective mechanism of the body. Three sessions of fever are given, separated by intervals of three days, with a sustained rectal temperature of 105 to 106° F. for five hours. The patient is kept in the hospital during the period of treatment.

The three cases are presented in detail. All three patients were in the habit of drinking unpasteurized milk. Two of the three showed destructive changes in the vertebrae and all were rendered symptom-free by treatments in the Kettering hypertherm. There was demonstrable repair of the bony lesions. One of these lesions had consisted of destruction of the posterior inferior border of the fifth lumbar vertebra with narrowing of the lumbo-sacral interspace. The destructive changes in the other case involved the third lumbar vertebra and were associated with compression and wedging of the second lumbar vertebra with narrowing of the second lumbar interspace.

That spondylitis in these three cases was caused by the Brucella infection is more or less proved (1) by the fact that prompt remission of the symptoms of spondylitis occurred in each case following fever therapy, (2) by the fact that this therapy has been shown to be effective in most cases of brucellosis without bony lesions in which the authors have had experience. Common forms of spondylitis do not respond favorably to physically induced hyperpyrexia. The prompt relief which immediately followed the fever treatment in each of these three cases could scarcely be attributed solely to coincidental spontaneous remission.

CLARENCE E. WEAVER, M.D.

Cervicobrachial and Lumbosacral Radicular Syndromes of Vertebral Origin. Marcel Monnier. Schweiz. med. Wchnschr. **71:** 1480–1482, Nov. 22, 1941.

This report is based on 100 cases, 80 of lumbosacral and 20 of cervicobrachial pain. The symptoms are (1) sensory changes, such as local tenderness over one or more vertebrae on percussion, sensitiveness of the nerve roots or trunks to pressure, pain on flexion, extension, or stretching, or zones of cutaneous sensory changes; (2) motor changes, which are rather uncommon; (3) alteration of the reflexes; (4) vegetative nervous system changes.

Of the 80 patients with lumbosacral complaints, 24 had forward or backward displacement of the fifth lumbar vertebra; 23 had thinning of the lumbosacral disc; 4 had sacro-iliac arthritis, and in the other 29 the x-ray appearance was normal. The usual etiological factor was trauma, but 7 cases followed exposure to humidity and cold and 2 cases followed an intercurrent infection.

Therapy should be directed to the diseased vertebra, with appropriate symptomatic treatment.

LEWIS G. JACOBS, M.D.

Pathogenesis of Sciaticas and Brachialgias. Traumatic and Degenerative Disc Changes. G. de Morsier. Schweiz. med. Wchnschr. **72:** 249–257, Feb. 28, and 277–279, March 7, 1942.

After a preliminary review of the various classical theories as to the pathogenesis of so-called sciatica, the author goes on to a discussion of the pathology of the intervertebral discs based on a correlation of the work of several observers. These discs form a quarter of the vertebral column and are composed of the cartilaginous plates, the annular fibrocartilage, and the nucleus pulposus. The discs contain neither nerves nor blood vessels. The posterior vertebral ligament is very strong in the mid-line, but weak on the sides.

Disc herniation is a result of a combination of degenerative changes and trauma. The trauma is either a severe effort or a fall on the feet. Symptoms vary with the location. In the cervical and thoracic region they are principally those of compression of the cord; in the lumbosacral region, of compression of the nerve roots, such as loss or decrease of the tendon reflexes, hypotonicity, zones of anesthesia or hypesthesia, alteration of the cutaneous reflexes, and paresis or paralysis

of the root type. Diagnosis is facilitated by lipiodol studies, but a normal picture does not rule out a herniated disc. Edema of the disc or annulus fibrosus leads to the more acute phases of the condition. As a rule, herniation is to one side of the mid-line.

In order to compare the symptoms of disc herniation, with those of so-called sciatica, the author studied 150 cases of the latter syndrome. All the patients were found to have a definite radicular syndrome suggesting lumbosacral compression, which could be localized sharply to one segment by careful consideration of the symptoms. Certain fixed signs were also present: pain on pressure over the lumbosacral joint or the joint between the fourth and fifth lumbar vertebrae was most constant. Loss of the lumbar lordosis, scoliosis toward the unaffected side, rigidity, pain on forced flexion of the thigh, and pain on coughing, sneezing, or defecation are also observed. An important radiological sign is decrease in the height of the lumbosacral disc, but a normal looking disc is not of necessity free from disease. Sciatica may be due to trauma or severe effort, degenerative conditions (sometimes familial), and occasionally a sustained mild effort.

From this comparison it is apparent that nothing in the history or clinical examination allows a distinction to be made between sciatica and disc herniation. Several cases of sciatica in which the presence of a prolapsed disc was demonstrable are recorded here.

Analogous to sciatica is brachialgia, which is associated with disc changes in the fifth, sixth, or seventh cervical vertebrae. As a rule the onset is sudden. The neck is held in a position which minimizes the pain. The patient feels better recumbent with the head supported, but pain recurs on rising. Coughing or sneezing aggravates the pain. As a rule, this is localized in the supraspinous fossa and in the interscapular space, with radiation into the shoulder, neck, and arm. Paresthesia of the fingers and hypesthesia are common. Vasomotor disturbances may occur. The condition is more frequent in women, and favors the right side. X-rays usually show a spondylosis deformans. Neurological signs are present.

Treatment requires prolonged rest in the most comfortable position. All manipulative maneuvers should be abandoned. Heat and purging (to reduce the disc edema) may be found helpful. Opiates may be needed to relieve the pain. The treatment giving the best results in de Morsier's hands is radiotherapy. If this is ineffective, electrophoresis with calcium or aconitine can be used. Putti's method of extension by the head and application of a corset may be employed if rest is insufficient. Operation should be reserved for those cases which do not respond to conservative management. LEWIS G. JACOBS, M.D.

Juvenile Osteochondreal (Chondro-Epiphysitis) Hypothyroidism. Robert L. Schaefer and Frank H. Purcell. Am. J. Surg. **54:** 589–604, December 1941.

The authors have previously recorded their conviction that so-called juvenile chondro-epiphysitis is due specifically to hypothyroidism, with the consequent lack of the tissue-differentiating factor (J. A. M. A. **112:** 1917, 1939. Abst. in RADIOLOGY **34:** 387, 1940). The present paper stresses the importance of chondro-epiphyseal changes as evidence of hypothyroidism and as an indication for thyroid therapy regardless of the clinical syndrome presented by the patient.

In support of this position, 27 cases of juvenile osteochondritis are recorded. These cases, diagnosed by "a cross-section of able roentgenologists," are variously classified as Perthes' disease, slipped upper femoral epiphyses, Osgood-Schlatter's disease, apophysitis, Köhler's disease, and epiphysitis of the spine. The patients ranged in age from five to fifteen years. Each one received as a routine desiccated thyroid orally in full therapeutic doses, and in all normal ossification of the epiphyses was hastened as a result of the treatment, as demonstrated roentgenographically. Patients displaying other signs of endocrine dysfunction, such as late descent of testicles and delay in adolescence, received pituitary hormone as well. Except in one case of Osgood-Schlatter's disease immobilization was not required, and in this case it was continued for only two weeks.

The authors conclude that the pre-accepted orthopedic methods for treating so-called juvenile osteochondritis are fundamentally incorrect and that they should be employed only as secondary measures, adjuvant to basic thyroid therapy.

Some Minor Injuries of Bones and Joints. E. Samuel. Brit. J. Radiol. **15:** 77–84, March 1942.

The increase in the amount of minor trauma received incidental to war service calls attention to the importance of these conditions, which, if they are overlooked or improperly treated, may produce permanent disability. In most of the conditions serial examinations are necessary, as the results do not appear immediately after the injury.

The commonest of the minor lesions incident to trauma is a simple periosteitis following a small injury. There may be no immediate change on the roentgenogram, but with the passage of time a thickening of the periosteum appears without alteration of the underlying bone. This is the result of a small subperiosteal hemorrhage.

March fracture, or fatigue fracture, is commonest in the second metatarsal of the foot. X-ray examination after a complaint of pain in the region reveals a small linear fracture, with subsequent periosteal proliferation and eventual healing. These fractures may occur in other bones. They have been observed in the neck of the femur.

Myositis ossificans following a slight trauma is sometimes observed.

Small chip fractures may be associated with sprains. These are important to recognize, as there is apt to be subsequent calcification in the healing process.

Osteochondritis dissecans is the most frequent lesion of articular cartilage. Its early recognition is important, as delay in treatment is apt to lead to permanent disability. This condition cannot be ruled out on one examination, nor on anteroposterior views alone. Obliques and serial examinations are necessary.

A rare form of injury is avascular necrosis of bone following trauma. This may not appear for several months after the injury.

In the knee joint after injury to the menisci or cruciate ligaments, recurrent effusions with thickening of the capsule are apt to occur. This may lead to a clinical diagnosis of tuberculosis. On x-ray examination, however, the picture does not resemble tuberculosis. There is irregular mottled atrophy without bone destruction.

The author includes case reports and roentgenograms. SYDNEY J. HAWLEY, M.D.

Question of Vertebral Fractures in Convulsive Therapy and in Epilepsy. Harry J. Worthing and Lothar B. Kalinowsky. Am. J. Psychiat. **98:** 533–537, January 1942.

This contribution to the subject of vertebral fractures as a complication of convulsive therapy by metrazol or electric shock deals solely with clinical problems. The authors first consider the possibility of late sequelae, which has been largely neglected in the literature. Eight patients in whom multiple fractures had occurred were re-examined after two years. In all complete healing had occurred. No progressive pathological changes were observed; there were no deformities and no neurological sequelae.

Fractures have been found to be less frequent in electric shock therapy than with the use of metrazol. Their incidence with either measure is greatly reduced by keeping the spine in extreme hyperextension.

A special study was made of a series of 42 epileptic patients to determine whether similar fractures occurred in that disease and reports of others were studied with this point in mind. While fractures do occasionally occur in epilepsy, these are in no way comparable to the fractures induced by convulsive therapy, differing in both location and character. Vertebral fractures occurring in tetanus, on the other hand, have the same localization and about the same frequency and multiplicity as fractures induced by metrazol therapy when no precautions are taken. This difference in the occurrence of fractures in different convulsive conditions is explained by the difference in the onset of the convulsions. With metrazol and tetanus this is abrupt and violent as compared with the ordinarily gradual onset of an epileptic seizure.

Significance of Vertebral Fractures as a Complication of Metrazol Therapy. Norman L. Easton and Joseph Sommers. Am. J. Psychiat. **98:** 538–543, January 1942.

The authors review the literature and record a study of 200 patients examined roentgenologically before and after metrazol therapy. Forty-six patients, or 23 per cent, sustained fractures of one or more vertebrae. The incidence was higher in males and was greater in patients under twenty-one and over fifty-five than in those of middle age. The mental condition of the patient seemed to play no etiologic rôle. No evidence was found that metrazol has any effect on calcium metabolism.

All of the fractures occurred in the dorsal spine and were limited to the body of the vertebra. No dislocations occurred, which explains the absence of cord involvement. Like other investigators, the authors found the symptoms to be much milder than would be expected in view of the roentgen findings.

It is believed that a more careful selection of patients and improved mechanical support of the spine during treatment will diminish the incidence of these fractures. Kyphosis, scoliosis, arthritis, nuclear change, and old fractures are not contraindications to this mode of therapy. It should probably not be undertaken in the presence of osteoporosis.

Pseudofracture of the Tibia. Report of Two Cases. J. Lloyd Tabb and Bernard D. Packer. Am. J. Surg. **54:** 737–740, December 1941.

The authors report two cases of so-called pseudofracture of the tibia, which is allied to march fracture of the metatarsals. The condition is of clinical importance because of the possibility of confusion with traumatic fracture, Ewing's sarcoma, or osteomyelitis. Diagnosis is made chiefly on the basis of roentgen studies. In the earliest cases there is a circumscribed area of lessened density at the junction of the upper and middle thirds of the tibia, central in location in reference to the diameter of the shaft, and at a point about 3 1/2 inches below the knee joint line. There is no soft tissue swelling and no generalized osteoporosis. The rarefied area soon changes to one of localized sclerosis. The latter is characteristic in that it is distributed transversely across the diameter of the shaft, showing several short criss-crossed lines of rarefaction and the presence of new subperiosteal bone. The new bone is most prominent at the posterior aspect of the tibia, at which point it produces a definite "peak." There is only a very slight amount of new subperiosteal bone on the anterior surface. The medial surface also shows the increased periosteal bone with the "peak phenomenon" and a rather smooth deposition of bone on the lateral interosseous surface. As the condition heals, the subperiosteal deposits of new bone become distributed in a more uniform and fusiform manner, replacing the "peak phenomenon." The fact that most of the new bone is laid down on the posterior and medial surfaces would indicate that bone proliferation in this condition follows the line of greatest stress and strain to which the tibia is subjected. Subsequent pictures show that the area of sclerosis becomes narrowed down and a transverse, fracture-like line begins to make its appearance, developing at the periphery and approaching the center. This fracture-like line, which is the most characteristic feature of this condition, is a late progressive phenomenon, extending through the new subperiosteal bone, in contradistinction to a true fracture line, which stops at the callus.

Recovery is the rule, following conservative measures or without treatment.

GYNECOLOGY AND OBSTETRICS

Clinical Application of Roentgen Pelvimetry and a Study of the Results in 1,100 White Women. Herbert Thoms. Am. J. Obst. & Gynec. **42:** 957–975, December 1941.

The author reviews the structural features of the female pelvis, comparing it with the pelvis of the newborn and the adolescent, and with the adult male pelvis. To simplify the estimation of pelvic capacity he considers separately three planes: the plane of the pelvic inlet, the midpelvic plane, and the pelvic outlet. In the plane of the *pelvic inlet* the essential diameters, obstetrically, are (1) the anteroposterior, extending from a point on the posterior surface of the symphysis, 1 cm. below its superior border, to the anterior surface of the upper sacrum at the point where the iliopectineal lines would meet were they to be extended; (2) the transverse diameter, which is the widest distance between the iliopectineal lines; (3) the posterior sagittal diameter, which is that portion of the anteroposterior diameter posterior to its point of intersection by the transverse diameter. In the *midpelvic plane*, also, three diameters call for determination: (1) the anteroposterior, extending from a point on the lower border of the symphysis at the level of the ischial spines, to fall usually at a point at or near the junction of the fourth and fifth sacral vertebrae; (2) the transverse

diameter, which is the narrowest distance separating the ischial spines; (3) the posterior sagittal diameter. The two diameters of the *pelvic outlet* most useful as an index of pelvic capacity are (1) the so-called widest diameter of the outlet and (2) the "pubotuberous diameter," which is the perpendicular distance from the ischial tuberosity to the iliopectineal line.

All of these essential diameters can be measured satisfactorily by roentgen means. For routine purposes the author recommends two flat films: one of the pelvic inlet looking into the pelvic cavity, which is spoken of as the "inlet" view, and one depicting the lateral aspect of the pelvis, both taken at 38 in. target-film distance. The technic for both projections is given in detail.

The classification of pelvic variations used by the author is based upon the conformation of the inlet. He recognizes four basic types. (1) In the dolichopellic or elongated type the anteroposterior diameter exceeds the transverse diameter. (2) In the mesatipellic or round type the anteroposterior and transverse diameters are of equal length, or the transverse diameter exceeds the anteroposterior diameter by not more than 1 cm. (3) In the brachypellic or oval type the transverse diameter exceeds the anteroposterior by more than 1 cm. and less than 3 cm. (4) In the platypellic or flat type the transverse diameter exceeds the anteroposterior by 3 cm. or more.

In this paper observations are recorded in 1,100 white primiparous women with delivery at term (the criterion for a term birth being a weight of not less than 2,500 gm.). In 205 of this group (18.6 per cent) the pelvis was found to be of the dolichopellic type; in 505 (45.9 per cent) of the mesatipellic type; in 354 (32.2 per cent) of the brachypellic type; in 36 (3.2 per cent) of the platypellic type.

A special study of the pelvic diameters was made in smaller groups of women and the results are presented in a number of tables. On the basis of his observations the author concludes that for classification of the pelvis as to size the anteroposterior diameter of the inlet may be used as a criterion. Thus a pelvis of the dolichopellic type with an anterior posterior inlet diameter of less than 12 cm. is "small," as is a mesatipellic pelvis of less than 11.5 cm. or a brachypellic pelvis of less than 10.5 cm.

In a group of 500 patients, labor was terminated by operation in 33 or 6.6 per cent. In 16 of these the operations were done chiefly or solely because of abnormal pelvic conformation. The figures for the different types were dolichopellic type, 2.6 per cent; mesatipellic, 0.4 per cent, brachypellic, 7.6 per cent, platypellic, 10 per cent. The highest percentage of low forceps deliveries was in the dolichopellic type, 23.8 per cent, followed by the mesatipellic, 20.6 per cent, and the brachypellic, 15.9 per cent.

As to the etiology of pelvic variations the author suggests the possibility that both nutritional and hormonal influences play a part.

Roentgen Pelvimetric Analysis of Walcher's Position. Harold M. Brill and Gerhard Danelius. Am. J. Obst. & Gynec. **42:** 821–835, November 1941.

The Walcher position of extreme body hyperextension during labor has been widely recommended as a useful procedure, aiding the entrance of the fetal head into a moderately narrowed pelvis. According to Walcher, an increase of the diagonal conjugate from 0.8 to 1.3 mm. was obtainable in the position recommended by him, and others have concurred in this view. It is to be noted, however, that these figures represent a comparison of the extreme exaggerated lithotomy position and extreme hyperextension. Since the purpose of Walcher's position is to facilitate the entrance of the fetal head into the inlet, thus indicating its use during the first and second stage of labor, it is obvious that the extreme lithotomy position need not be considered here, and that logical comparison is between the ordinary comfortable dorsal position and the Walcher position.

Such a comparison has been made by the authors, who have carried out a roentgen study of the pelvis in 20 patients—10 in labor and 10 during gestation. The method of roentgenography and of calculation of the pelvic dimensions is described, and results obtained in the 10 women are tabulated. These indicate that, on an average, the length of the obstetric conjugate in the Walcher position differs from that in the comfortable dorsal position by only about 0.25 cm., and shortening is observed more often than lengthening.

In a comparison of the moderately flexed position with Walcher's position an apparent increase in the length of the obstetric conjugate, averaging about 0.4 cm., was observed. This apparent lengthening actually is only the recovery of the original shortening of the obstetric conjugate artificially produced through the change from the comfortable dorsal to the lithotomy position. In none was there even an approach to an increase in the obstetric conjugate "of from 0.8 to 1.3 cm.," as claimed by Walcher.

In the light of these observations the authors believe that the advantages of the Walcher position must be explained on some other basis than a lengthening of the conjugate. They suggest the increased muscular tension and the altered angle of inclination as possible factors. They conclude further that in difficult breech extraction, in a normal profiled sacrum, it is advisable to change from the lithotomy to the Walcher position for delivery of the shoulders and aftercoming head, because the artificially shortened conjugate will thus recover its loss; that in flat sacrum pelves with an anterior sacral prominence, Walcher's position is contraindicated, while the lithotomy position will give additional space at the inlet; that theoretically, a device such as a low abdominal pressure-band and an elevation of the lumbar spine to a moderate lordosis may produce the advantages claimed by Walcher in a manner far less distressing to the patient.

THE GENITO-URINARY TRACT

Use of Cysto-Urethrogram in the Diagnosis of Various Conditions in the Lower Portion of the Urinary Tract. Henry Mortensen. M. J. Australia **1:** 157–160, Feb. 7, 1942.

The author's cystographic technic consists in the injection of solutions of sodium iodide, up to 4 per cent in strength, into the urethra at a pressure of 100–150 mm. of mercury, following cleansing of the bowel by an enema. Pictures are made during the injection of fluid with the tube centered just above the pubis and having a slight tilt downward. Oblique views are made if diverticula of the bladder are seen. Pictures obtained after micturition give a visual demonstration of the amount of residual urine, if any, and may reveal stasis existing in a diverticulum. For

the urethrogram a lipiodol solution is used, with the patient in a right lateral position, with the left leg extended, the right leg flexed to a right angle, and the penis extended below and parallel to the thigh.

The chief dangers associated with the examination are extravasation in the presence of stricture or similar pathology, and the possibility of an oil embolism. Acute infection is, of course, a contraindication.

Drawings representing the normal cystographic and urethrographic pictures are reproduced, as well as a series of cystograms and urethrograms in various pathologic conditions. Diverticula, carcinoma, stones, fistulae, cord bladder, bladder neck obstruction due to prostatic disease, and stricture of the urethra are all demonstrable. An interesting finding in chronic prostatitis is the presence of isolated cavities of varying size opening by a narrow orifice in the region of the verumontanum, or there may be giant cavities occupying a large portion of the prostate, or lesions of radiating prostatitis characterized by a number of small or large cavities communicating with each other and producing a tree-like appearance. Such films evidence the futility of the usual methods of treatment for chronic prostatitis of this sort and indicate surgical treatment by incision with electrode knife or removal of the overlying tissue by periurethral resection to produce adequate drainage. WM. H. GILLENTINE, M.D.

THE SPINAL CORD

Two Cases of Myelodysplasia. A. Austregesilo and A. R. de Mello. J. Nerv. & Ment. Dis. **94:** 529–539, November 1941.

In 1909 Alfred Fuchs introduced the term "myelodysplasia" to indicate a congenital defective development of the spinal cord due to incomplete closure of the embryonic neural tube. Clinically the disease is characterized by sensory and trophic changes, particularly of the lower extremities.

The roentgenographic changes noted in the disease consist usually of a spina bifida in the lower lumbar or sacral portion of the spine, an irregular contour of the metatarsophalangeal surfaces, and irregular bone proliferation of the distal end of the metatarsal of a great toe. Decalcification of the bones of the foot also may occur. CORNELIUS G. DYKE, M.D.

RADIOTHERAPY

MALIGNANT TUMORS

Bone Tumors with Reference to Their Treatment. Murray M. Copeland. Surgery **11:** 436–455, March 1942.

In appraising any method of therapy it is necessary to know the essential pathology, the natural history of the disease, and what influence specific therapy may have upon it. The classification of bone tumors based upon the relation of bone development and subsequent tumor formation separates the tumors into specific types, each of which follows a definite course.

I. Tumors derived from precartilaginous connective tissue
   - Osteochondroma
   - Primary chondromyxosarcoma
   - Secondary chondromyxosarcoma
   - Osteoblastic osteogenic sarcoma

II. Tumors related to subsequent cartilaginous growth
   - Bone cyst
   - Benign giant-cell tumor
   - Chondroblastic sarcoma
   - Osteolytic osteogenic sarcoma

III. Certain tumors of non-osseous origin intimately connected with the bone
   - Ewing's sarcoma
   - Multiple myeloma
   - Fibrosarcoma
   - Metastatic carcinoma
   - Angioma
   - Recurrent myositis ossificans
   - Hand-Schüller-Christian's disease

The author states that no comprehensive rule can be laid down as to whether a tumor process is radiosensitive or not, since the term radiosensitive is a relative one. A shift in technic frequently results in a change in the response of the tumor.

The radiosensitivity of a tumor depends upon both the histologic characteristics of the tumor cells and the nature of the surrounding tumor bed. It cannot be determined by microscopic examination alone. In general radiosensitivity increases with the embryonal quality of the tumor or anaplastic changes, but this statement must be qualified for those tumors which seem to have inherent radioresistant growth properties. The tumor bed is of great importance. Where cartilage and bone are concerned, two factors make for radioresistance: (1) very little reaction to irradiation by the individual cells; (2) an avascular type of tumor bed. Edema and infection also increase resistance. Radiosensitivity does not parallel radiocurability.

The author sets forth the following fundamental points:

(1) Regardless of the type of sarcoma, irradiation alone has rarely sufficed to accomplish a cure, while combined with resection it has offered better results.

(2) Amputation is favored as a method of treatment.

(3) Tumors with long preoperative symptoms are less aggressive in character and the patients survive in larger numbers.

(4) Tumors with short preoperative symptoms usually connote a more aggressive process, with a reduction in case survivals.

(5) The primary bone sarcomas which show the greatest tissue differentiation yield the largest percentage of cures when treated adequately.

(6) Early diagnosis and aggressive treatment are to be recommended.

As to the different types of tumor:

Chondroma and *osteochondroma* are radioresistant.

The various forms of *osteogenic sarcoma* are in general radioresistant. An occasional case of sarcoma becomes sterilized by x-ray treatment but the function of the extremity is also destroyed. Irradiation is of advantage only as a palliative procedure.

Chondroblastic sarcoma is controlled by irradiation despite its inherent radioresistant qualities.

Many *giant-cell tumors* of bone are radiosensitive, though the tissue changes which occur are hard to explain. Over-treatment must be guarded against, as devitalized normal bone does not make a satisfactory result.

Multiple myeloma is moderately radiosensitive. The larger the area of bone destruction, the less satisfactory is the response. Palliation by moderate doses of irradiation is satisfactory, however, and partial sterilization of the tumor process may be obtained.

Fibrosarcoma is not usually radiosensitive, and only very low-grade malignant tumors may be controlled by therapy.

Hand-Schüller-Christian's disease is quite sensitive to x-rays and favorable results are the rule if the patient is kept under observation.

JOHN E. WHITELEATHER, M.D.

Limitations of Irradiations of Solid Renal Tumors in Children. H. O. Mertz, R. D. Howell, and J. W. Hendricks. J. Urol. **46:** 1103–1128, December 1941.

The discussion of this paper and the authors' rebuttal which accompany its publication enhance its value.

Although the early enthusiasm for irradiation in treating solid renal tumors has been tempered by eventual failures, reported instances of apparent clinical cure suggest that close study of the problems of irradiation correlated with careful postoperative or postmortem study of the kidneys might explain these occasional apparent successes. Irradiation has, therefore, been accepted as the method of choice in treating renal tumors in the James Whitcomb Riley Hospital for children in Indianapolis. Three carefully followed interesting cases are reported. One of the patients (Case 3) is yet alive with no evidence of recurrence, having received ten series of x-ray treatments, totalling 16,355 r (tumor dose).

Recurrence took place in Case 2 after irradiation totalling 7,000 r and in Case 3 after a tumor dose of 13,105 r. X-ray therapy was ineffective in treatment of the recurrent tumors in the loin and the metastatic tumor in the bladder. It is probable that in many patients extrarenal extensions of the growth or metastatic lesions are overlooked when treatment is instituted and these may account for many instances of failure following x-ray therapy. This fact would suggest wider distribution of portals of entry, rather than limitation to the three usually employed.

Functional study of the kidney opposite the one irradiated suggested that with dosage of 100 r it probably suffers no lasting damage, while the secretory function of the kidney on the irradiated side may be destroyed. The disappearance of physical and pyelographic evidences of the disease is prone to create an unwarranted sense of security in the minds of both the patient and the doctor, resulting in a relaxation of continued aggressive irradiation.

In the future, the authors stated in their rebuttal of the varied and valuable discussion, their plan of management will be irradiation when a mass in the side is present and it is proved to be renal and not a hydronephrosis. If the tumor does not show evidences of responding to irradiation, the patient will be operated upon immediately because of the possibility of a cystic tumor. B. H. ORNDOFF, M.D.

Experiences in the Treatment of Carcinoma of the Prostate with Irradiation of the Testicles. Arbor D. Munger. J. Urol. **46:** 1007–1011, November 1941.

Castration has been invoked for prostatic hypertrophy on various occasions from the days of early medicine. It has long been known that pregnancy or the suppression of ovarian activities, as by irradiation in a carcinoma of the breast, definitely retards metastasis and, in certain instances, apparently causes regression. In consideration of the theory of hormonal relationship to hypertrophy of the prostate, and possibly the malignant degeneration which occurs therein, the author reasoned that perhaps a suppression of testicular hormonal activities by irradiation might in some way influence prostatic carcinoma which makes its occurrence in already established hypertrophy.

He concluded from a clinical study of his cases of carcinoma of the prostate that slightly better results were obtained in those cases treated by testicular irradiation with prostatic resection than in cases treated by resection and x-ray exclusive of testicular application. Of 45 patients treated by resection and x-ray, only 10 survived, whereas of 11 treated by resection and irradiation including application to the testicles, 8 survived.

The author believes that supervoltage irradiation far outranks the more commonly used type, usually 200 kv. Small doses of radiation achieve only poor palliative results. Better palliative results and a decrease in the subjective symptoms are obtained proportionately to higher doses used and to protraction of fractional treatment to the several definitely mapped out areas until each of the portals has received usually 3,000 r.

The paper concludes with a plea for the enhancement of diagnostic aids in early carcinoma of the prostate, for a more satisfactory classification to facilitate therapy and prognosis, and for year-after-year reports before the American Urological Association of large series of treated cases to aid in the solution of the problems of treatment. B. H. ORNDOFF, M.D.

Complications of Irradiation Treatment of Carcinoma of the Cervix. W. G. Cosbie. Am. J. Obst. & Gynec. **42:** 1003–1008, December 1941.

The present study is based on 320 patients treated radiotherapeutically for cancer of the uterine cervix during the years 1936–40. In 1936 radium was used in massive doses within the uterus and on the vaginal aspect of the cervix, supplemented by fractionated 200 kv. roentgen therapy. In 1937 a change in technic was made, whereby the radium treatment was fractionated according to the method of Regaud and the roentgen treatments were given before the application of the radium. In 1938 and 1939 400 kv. therapy replaced the 200 kv., 2,400 r being given routinely to each of 4 ports and 900 r on the perineum. This was followed by radium according to the Regaud technic. Late in 1939, a vaginal cone was adopted instead of the perineal port to supplement the pelvic high-voltage cross-fire. By this means, a dose of 3,000 r was delivered directly on the cervical area. A central posterior field was added or, in very heavy women, two lateral fields. While this gave a depth dose of satisfactory concentration and distribution, and brought about a rapid response, the frequency of complications was increased.

The complications observed in this series were the usual ones of infection following intra-uterine introduction of radium, especially before preliminary roentgen therapy was adopted; primary proctitis, which was observed most frequently following massive radium dosage, and late ulceration of the rectum, which became more common when the high-voltage therapy

was increased and the radium fractionated; bowel injuries, especially common with the heavy depth dosage used in 1940; urinary tract complications; vesico-vaginal fistula.

Delivery of a lethal radiation dose to a pelvic carcinoma always carries a risk of exceeding the tolerance of the adjacent normal tissues but, the author asks, since certain complications are accepted as frequently associated with surgery, "is it not reasonable to accept some of the complications which have been described as part of the risk in the treatment of advanced cases which are quite beyond the scope of any form of treatment?" He adds: "The lesson to be learned from an appreciation of these complications is that we are feeling our way toward an ideal method of irradiation treatment and must be guided by our failures as well as by our successes."

Sterilization of the Ovaries by Roentgen Rays in the Treatment of Distant Metastases from Primary Carcinoma of the Breast. Report of Two Cases. Ernst A. Pohle. Am. J. Surg. **54:** 490–493, November 1941.

Two cases are recorded in which roentgen castration produced palliation in women with pulmonary and osseous metastases from a primary breast cancer. Calcification of the bone lesions occurred and the deposits in the lungs disappeared. These effects the author attributes, at least to a large extent, to withdrawal of the ovarian hormones.

Carcinoma of the Esophagus. Torek's Operation, Recovery. Oscar Ivanissevich and Roberto C. Ferrari. Surg., Gynec. & Obst. **74:** 47–52, January 1942.

A case of esophageal carcinoma is described in a man of fifty-two, an Argentinean, which was treated by Torek's operation as modified by the authors. They attribute a decisive rôle in their favorable result to preliminary pneumothorax according to Arce's technic. Five months after operation the patient was well, showing a gain in weight, a normal blood count, and good nutrition.

The technic of the surgical procedure is described in detail and well illustrated.

Carcinoma of the Colon and Rectum: A Study of Metastasis and Recurrences. Charles W. Mayo and Carl P. Schlicke. Surg., Gynec. & Obst. **74:** 83–91, January 1942.

This study of metastases and recurrence covers 334 cases of primary adenocarcinoma of the colon and rectum coming to necropsy over a period of five years. The observations are based not only on the findings postmortem but also on the operative observations in those cases which were treated surgically. Metastases were present in 60.5 per cent of the series. Their incidence was highest in carcinoma of the transverse colon, followed by the rectosigmoid and splenic flexure. After the regional nodes the liver was the most frequent site of secondary growth. Local invasion occurred in 39.2 per cent of the 334 cases, being most common when the primary growth was in the splenic flexure.

Cases in which death occurred shortly after operation were regarded as specially suitable for appraising the ability of the surgeon to recognize metastases. A study of 131 such cases showed this ability to be good. In 82.4 per cent of the group in which no metastases were found at operation, none was discovered at necropsy. The success of extirpation was revealed in this same group of cases, 65 per cent of those in which there was metastasis at operation being free of it at necropsy. Residual cancer was found in only 5.3 per cent of the cases in which death occurred shortly after resection. In those cases in which the surgeon believed metastatic growth to be present in the liver, the pathologist confirmed the impression in 91.7 per cent.

In discussing the matter of recurrence after operation the authors call attention to the possibility of independent growths, either malignant or potentially malignant, in the remaining segments of the bowel. In the group of 169 cases in which curative resection was carried out, independent cancers were found in the bowel at necropsy in 7 cases, or 4.1 per cent.

The rôle played by adenomatous polyps is an important one. Polyps were present in 34.1 per cent of the cases in this entire series, in contrast to 16.0 per cent of a control series consisting of patients without cancer of the bowel. In 14.0 per cent of the cases in which polyps occurred, malignant changes were found.

In view of their observations the authors conclude that whenever a carcinoma is found in any portion of the colon or rectum, the presence of a second carcinoma must be carefully ruled out. After operation, the malignant potentialities of the remaining mucous membrane should be borne in mind and careful follow-up studies carried out. Only by thorough and painstaking investigations of each case will avoidable "recurrences," due to accessory lesions, be prevented.

Is Lymphosarcoma Curable? Arthur Purdy Stout. J. A. M. A. **116:** 968–970, March 21, 1942.

During the twenty-one-year period 1915–35 the author examined a total of 218 cases of lymphosarcoma with microscopic confirmation of the diagnosis. For 156 of these patients some form of curative therapy was attempted. The five-year survival rate is 16.5 per cent. The symptom-free survival rate is but 10.5 per cent. For the treated group the five-year survival rate is 21.8 per cent. One third of these patients are known to have had persisting disease at five years. The untreated group had a five-year survival rate of 3.2 per cent, but none of these was free from disease.

The five-year survival rate is better than average if the disease first manifests itself in the cervical, axillary, and inguinal nodes, the oral cavity and nasopharynx, the gastro-intestinal tract and the skin and orbit, and poorer than average if it starts in the retroperitoneal, mesenteric, or mediastinal nodes or in the spleen or thyroid, or is generalized. The prognosis is the poorest for the patient under twenty years. No patient who has survived ten or more years was in the first three decades of life when first treated. Six patients with lymphosarcoma died eventually with leukemia. Reticulum-cell tumors constituted the majority and showed a survival rate well below the average. Lymphocytic-cell tumors were next most frequent with a survival rate about 1 per cent above the average. The giant follicle tumors, with the smallest number of cases, showed a survival rate about 12 percentage points above the average.

The importance of early diagnosis is stressed. More frequent use of diagnostic biopsy without procrastination in cases of unexplained localized lymph node enlargements is urged.

Radiotherapy was the most frequently used form of

treatment. It was combined with surgery in a quarter of the cases. It is possible to have long survivals following surgical removal alone. Seven patients who were treated survived ten years and six of them are symptom-free. Only one survived ten years without treatment and died of lymphosarcoma. This gives one the right to anticipate that some of these clinical cures may be absolute. The favorable results have been obtained almost always while the neoplasm is still relatively localized. Since lymphosarcoma is generally radiosensitive, roentgen therapy is usually preferred. If surgery is the primary treatment, it is probably better to follow it with roentgen therapy. Cases associated with leukemia are always fatal. If the disease has involved more than two contiguous anatomic structures, the chances of a long symptom-free survival are remote. A long survival irrespective of degree of involvement or of treatment may be expected in between 2 or 3 per cent of all cases.

CLARENCE E. WEAVER, M.D.

Antileucocytic Sheep Serum as Sensitizing Agent in Chronic Myeloid Leuchaemia Refractory to Deep X-Ray Therapy. J. B. Thiersch. M. J. Australia **1:** 225–229, Feb. 21, 1942.

No treatment known at present for leukemia either cures the patient or prolongs his life greatly. Two patients suffering from chronic myeloid leukemia refractory to deep x-ray therapy were apparently benefited by injections of the serum of sheep that had been repeatedly injected with increasing numbers of leukemic cells of the myeloid series. Reactions developed six to seven hours after intravenous injection of this serum, consisting of a rise in temperature to 104° F., profuse sweats, and shock-like phenomena lasting for a few hours. In one case the patient's spleen, which had been refractory to deep x-ray therapy in doses of 660 r, became sensitive to 220 r after injection of the serum. In another patient an acute myeloblastic leukemia entered a chronic phase following administration of the serum alone. The serum requires two and a half to three months of careful work for preparation. The results are purely palliative.

WILLIAM H. GILLENTINE, M.D.

NON-MALIGNANT CONDITIONS

Some Observations on the Effects of Selective Irradiation of the Stomach in Cases of Chronic Non-Obstructive Duodenal Ulcer with Hyperchlorhydria. W. P. Holman and R. A. Lewis. M. J. Australia **2:** 735–740, Dec. 27, 1941.

The authors describe a treatment technic designed to eradicate acid-secreting cells of the stomach. A cumulative dose of 500 r to the stomach was given, the fractional method being used to minimize the possibility of irradiation sickness. To increase the tolerance of the skin the treatment was given through circular skin ports, 12.3 cm. in diameter, anteroposteriorly and postero-anteriorly, centering being checked by roentgenograms taken on the treatment couch, with the stomach filled with a barium sulphate suspension. Free hydrochloric acid was determined and plotted as a mean of eight samples of the "standard fractional test meal" against the time during and after treatment. Graphs for 13 cases are presented and in every case the level of free hydrochloric acid was reduced. This drop varied in degree and persisted after treatment for varying intervals, but the material is not sufficiently extensive to justify any attempt at explaining these differences. All the patients considered their condition improved. Further study is indicated before this work becomes of value.

WM. H. GILLENTINE, M.D.

Roentgen Therapy in Hereditary Diffuse Polyposis of the Colon. B. T. Vanzant. J. A. M. A. **118:** 875–878, March 14, 1942.

Diffuse polyposis of the colon is not a common disease, for only approximately 200 cases were to be found in the literature in 1938. Its hereditary character has been recognized only during the last twenty years. Malignant degeneration almost invariably occurs in one or more of the polyps.

Characteristically the onset of symptoms occurs at about twenty years of age. There are hypermotility of the bowel and diarrhea with an excess of mucus in the stools, which not infrequently contain blood from ulceration of the surface of the growths. The effect on general health depends on the amount of blood lost and on the severity of diarrhea and consequent malnutrition. According to Bargen, in a large percentage of cases some of the polyps have already undergone malignant changes at the time of the first consultation. In a survey of 127 published reports culled from the literature, Hullsiek found that 76 patients had received only medical treatment, and of these 56.5 per cent had died of the disease at the time the cases were reported. The surgically treated cases fared badly too, for of the 51 patients who were operated on 35.1 per cent had died prior to the report.

Fulguration is applicable only to rectal and sigmoid lesions. Colectomy is a formidable operation, usually requiring to be done in multiple stages over a considerable period of time from six months to one or more years. The mortality is high, the financial burden is great, and when the patient survives he is left with a mutilated body, requiring special attention to nutritional and excretory function.

Hyperplasia of lymphatic tissues and lymphatic infiltrations are characteristic features of this disease. These are peculiarly susceptible to irradiation. Treatment in the early stages of the disease should be particularly effective. Even after the lesions have advanced to the stage of mucosal hyperplasia and adenoma formation, the tissues are still radiosensitive. Prevention or postponement of malignant change should be possible with adequate dosage. Even after carcinomatous transformation has occurred, worthwhile temporary palliation and prolongation of life may be expected.

Two case reports are given. The patients were brothers. The first had widespread polyposis involving the entire colon. A total of 4,000 r with high-voltage technic were given in fractional doses over each segment of the abdomen during ten weeks. After a severe reaction there was rapid symptomatic improvement. Treatment was repeated three years later due to a relapse, and again there was a period of good health which lasted two more years. The patient died after recurrence of symptoms five years after the original treatment. The second patient was seriously ill and incapacitated for work. There was an associated amebiasis. A year of good health followed roentgen therapy. Death occurred twenty-seven months after the first treatment, reportedly due to amebic dysentery.

Unfortunately this was not confirmed by postmortem studies.

The author concludes that roentgen therapy is a logical and effective adjunct in the treatment of multiple polyposis. Symptomatic relief and a diminution in the size and number of polyps may reasonably be expected. CLARENCE E. WEAVER, M.D.

Treatment of Cutaneous Diseases with Radon Ointment and Radium Pads: Preliminary Report. Ludwig Isaak. Arch. Dermat. & Syph. **45:** 560–573, March 1942.

Radon ointment and radium pads are valuable assets in treatment of diseases of the skin. Radon ointment is made by thoroughly shaking melted petrolatum in the presence of radon gas. Its power of irradiation can be modified by changing the amount of gas or of petrolatum. Its radioactivity is lost at a fixed rate, half of its power being lost in 3.8 days in air-tight containers. When the ointment is exposed to the air the loss is much more rapid. The ointment is applied directly to the skin in a layer about 1 mm. thick and the area is immediately covered with oiled silk so as to keep it as air-tight as possible. Radon ointment may be given to the patient for home use; three to twenty applications are used according to the strength of the ointment.

A radium pad has a body of linen, or fine-mesh web of bronze or silver. The radium salt is mixed with lacquer and spread on thinly, this giving 0.5 mg. of radium element on a surface of 100 sq. cm. These pads are to be worn twelve hours daily for fourteen to eighteen days. The area treated should not be more than palm size. Patients are examined weekly.

The author in explaining the results obtained with these small amounts of radium says that all container walls absorb alpha and beta rays. By this method the first 10 mm. of tissue absorb these rays.

A chart summarizing 85 cases covering a wide variety of lesions is given, and a number of case reports demonstrate the usual conditions that are encountered. Favorable results were obtained in lichen simplex, lichen planus, eczema marginatum, kraurosis vulvae, and leukoplakia. The results are not as good in psoriasis or pruritus ani, vulvae, or scroti, but in many cases improvement has been noted.

JOSEPH T. DANZER, M.D.

DOSAGE

Threshold Erythema Dose of Roentgen Rays. I. Review of Literature and Comment on Variation of Doses in Use in Australia, the United States, and England. II. An Experimental Investigation of Various Aspects of the Erythema Reaction and a New Clinical Criterion for the Standard Threshold Erythema Reaction. John C. Belisario and Robert E. Pugh, Jr. Arch. Dermat. & Syph. **45:** 519–543, March, and 641–669, April 1942.

There has been much variation in the amount of reaction considered as indicating a skin erythema dose, and there has been no uniformity in the voltage or milliamperage used to obtain it. The size of the port varies with each investigator, and little or no attempt has been made to evaluate back-scatter when large ports are used. These were the findings of the authors who undertook this investigation in England, Australia, and the United States.

An experimental program was begun, and as a result, the authors state, "a new criterion of the threshold erythema reaction is proposed and defined, which, it is believed, would greatly increase the degree of accuracy with which different workers could correlate their observations."

An historical review divides this subject into two periods, the first from 1896 to 1929, which was before the establishment of a radiation unit in terms of ionization. Bowles, in 1896, is reported to have been the first to suspect that dermatitis was due to roentgen rays, and the first case of this kind was reported by Stevens in 1897. Microscopic studies of the skin during erythema were made in 1897. They were very complete and accurate. Although there was a great deal of investigative work concerning the establishment of a threshold erythema carried on in this period, Martius found differences as great as 258 per cent in the unit skin dose used by various workers.

In the period from 1930 to the present, the trend has been to correlate the erythema with the corresponding dose in international units, but the variations in milliamperage, voltage, and size of the port, the presence of shock-proof equipment in some institutions, and differences in filtration, are all factors that make comparison difficult.

In Great Britain there are seven types of dosimeter in use, while by dermatologists in the United States the Victoreen thimble-type is used almost exclusively. In the latter country most of the machines being used by dermatologists are calibrated by physicists. In Australia four different types of dosimeter are used.

The authors have defined a threshold erythema dose as "the minimal amount of roentgen irradiation which will produce an erythema or pink reaction within nine to fourteen days with a sharply defined complete edge, in a circular area 1 cm. in diameter on the upper anterior portion of the thigh." In 80 per cent of persons this was produced by 350 r, using 110 kv., 6 ma., 20 cm. target-skin distance, no filter. This has a half-value layer of 0.9 mm. Al without back-scatter. A port of 1 cm. diameter was used, as this is the largest area that is not affected to any appreciable extent by back-scatter.

Forty subjects were used to obtain data, their ages ranging from ten to seventy-five years; 480 test exposures were given. There appeared to be no difference in the results in males and females, but it was found that "older skins are less sensitive to radiation," and that "coarse greasy skins were much more tolerant to x-ray than those of fine texture." The various areas tested showed differences in sensitivity, the intensity of the reaction being greatest on the abdomen, followed in order by the flexor surface of the forearm, the upper anterior portion of the thigh, the flexor surface of the arm, the chest, the lower anterior aspect of the thigh.

A series of tests were done on infants from three weeks to six months of age. It was found that the threshold erythema required 200 to 350 r, which is a wider range than in adults.

JOSEPH T. DANZER, M.D.